SEPTEMBER 1960

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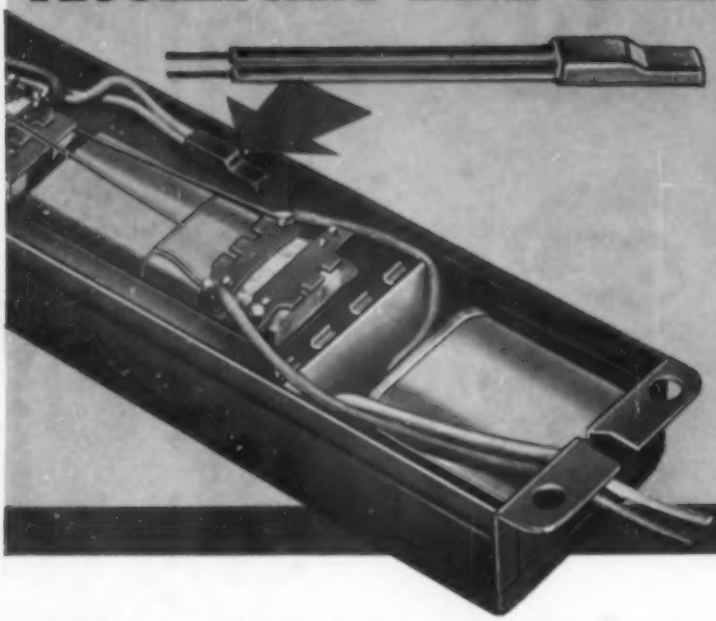
ILLUMINATING ENGINEERING

Journal of the
ILLUMINATING ENGINEERING SOCIETY

PROTECT FLUORESCENT LIGHTING INSTALLATIONS

with **ADVAN** guard

FLUORESCENT LAMP BALLASTS



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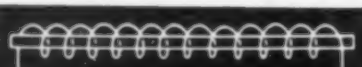

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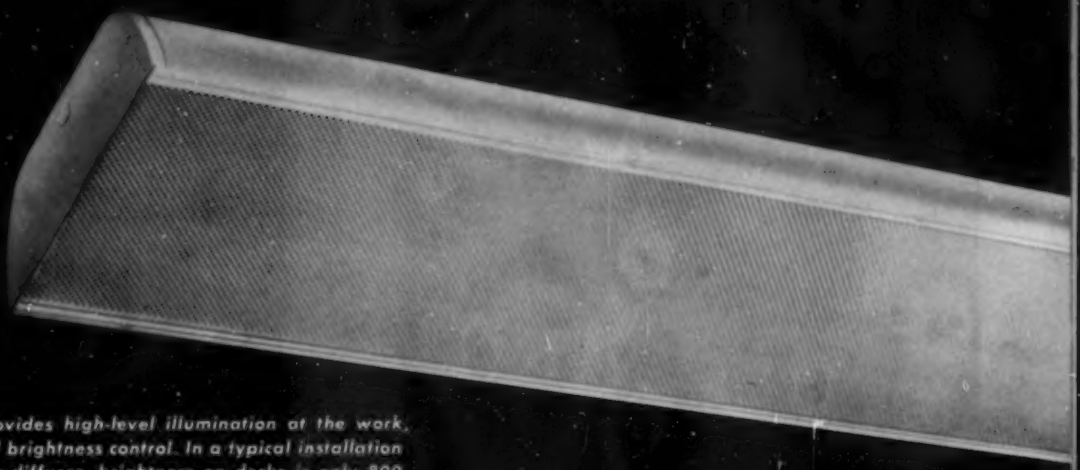


LPI Trend luminaire provides high-level illumination at the work surface with engineered brightness control. In a typical installation with a white ventrolens diffuser, brightness on desks is only 800 footlamberts compared to brightness of 2100 footlamberts for a conventional baffle-type unit in the same installation.

New LPI Trend luminaire provides high-level illumination, meets recommendations for visual comfort

Visual comfort at high illumination levels is now attainable in schools and offices with the new, economical LPI Trend series.

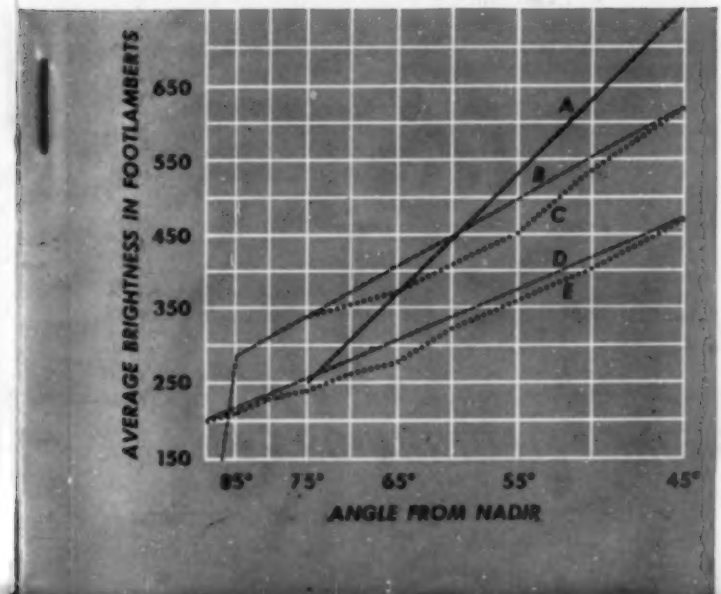
The design of the Trend luminaire combines luminous side panels with efficient diffusers. Both are engineered in shape and transmission characteristics to provide increased foot-candle levels while closely approximating the Illuminating Engineering Society's "scissor curve" for visual comfort.

The new design with luminous, wrap-around side panels makes the Trend luminaire efficient and attractive. Direct glare is well below levels commonly associated with conventional fixtures. The series offers a choice of three types of diffusers—clear ventrolens, white ventrolens to achieve minimum reflected glare, and a new polystyrene egg crate louver which provides 55° shielding both crosswise and lengthwise.

Trend series luminaires are offered in the following sizes for 430 ma rapid-start lamps: 4 ft. x 12 in. unit for two lamps; 8 ft. x 12 in., tandem arrangement for four lamps; 4 ft. x 16 in. for four lamps.

Visual comfort of the new Trend luminaire is depicted in the adjoining chart according to the "scissor curve" method recommended by the Illuminating Engineering Society. Average brightness levels are obtained in the crosswise and lengthwise directions at angles between 45° and 90° from nadir and are plotted on a chart. Also plotted is a straight line representing the I.E.S. recommended brightness limit and straight lines representing the luminaire's own brightness limits in the two directions. Because brightness measurements of the Trend luminaire in the critical crosswise direction fall below these lines, the luminaire may be said to meet I.E.S. recommendations for crosswise brightness control. Lengthwise measurements closely approach these recommendations and are well within the comfortable range.

For complete information on these attractive, moderately priced luminaires, write for LPI's Trend Bulletin.

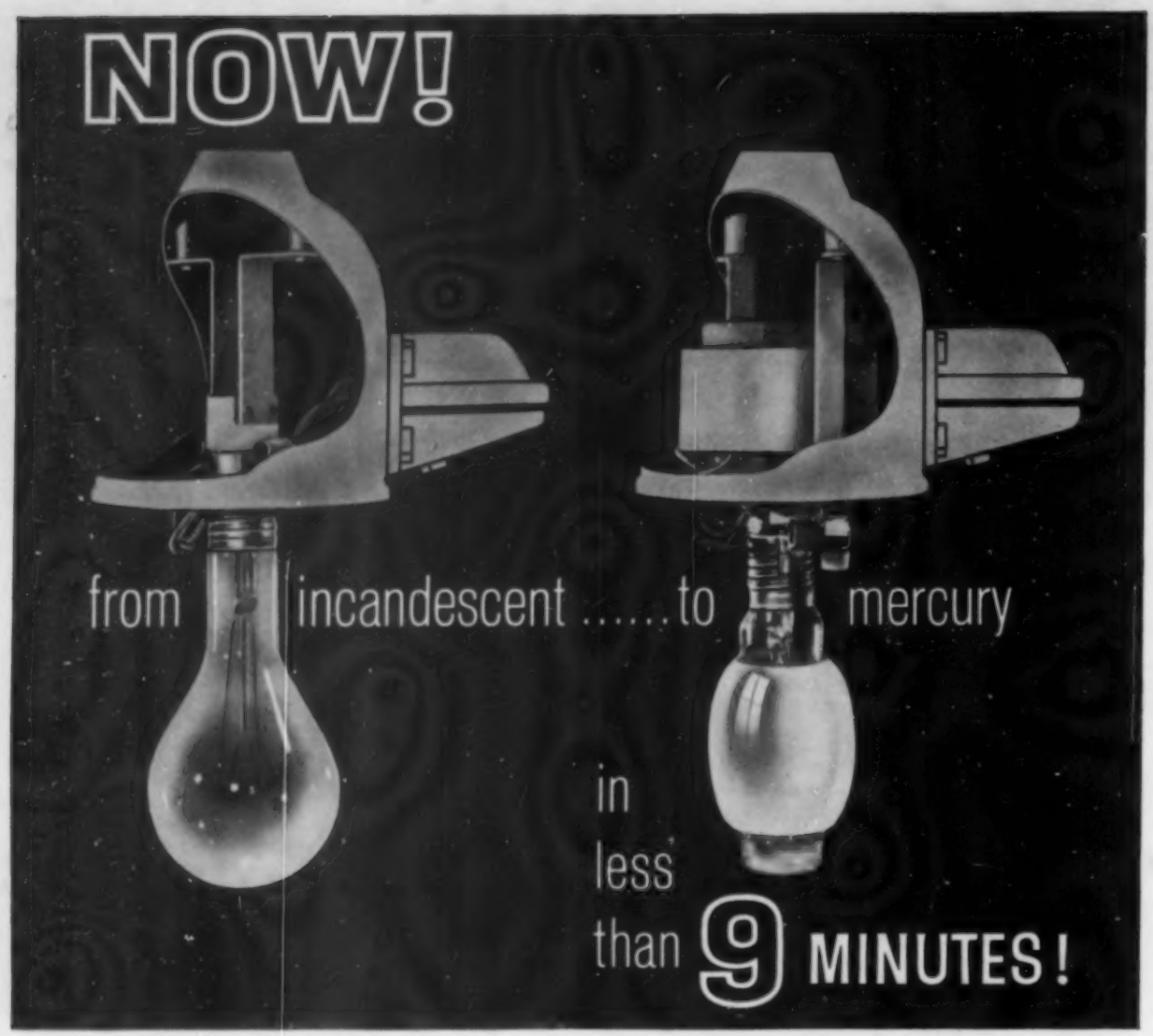


LPI FLUORESCENT LIGHTING

Lighting Products Inc., Highland Park, Illinois

Plot of average brightness in footlamberts in plane normal to lamps (crosswise of luminaire) and plane parallel to lamps (lengthwise of luminaire) for pendant-mounted LPI Trend luminaire—Catalog No. 7840-4, with CBM ballast and two F40T12/CW/RS lamps

A—I.E.S. recommended brightness limit (75°-45°)
B—Trend luminaire brightness limit—lengthwise
C—Trend luminaire average brightness—lengthwise
D—Trend luminaire brightness limit—crosswise
E—Trend luminaire average brightness—crosswise



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New Sylvania kits permit conversion of your existing heads to mercury in one easy operation. They're designed for EEI-NEMA type heads, and because the ballast is built right into the kit, time-consuming installation of remote-mounted ballasts is eliminated. Sylvania also offers the reactor separately for adaptation for other in-head ballast assemblies, and special mounting brackets where equipment requires.

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For technical details write for our new descriptive brochure on Sylvania Mercury Conversion Kits, Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept. 61, 60 Boston St., Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., P.O. Box 2190, Station "O," Montreal 9.

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ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

September 1960

Vol. LV, No. 9

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STATEMENTS and opinions in articles and papers in ILLUMINATING ENGINEERING are the expressions of contributors and do not necessarily represent the policies or opinions of the Society. Official Society opinions are expressed only in official committee reports specifically approved by the Council of the Illuminating Engineering Society.

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If a school building or remodeling project figures in your "tomorrow", consult your Day-Brite representative about the lighting designed with "tomorrow" in mind. *Day-Brite Lighting, Inc., 6260 N. Broadway, St. Louis 15, Mo. and Santa Clara, Calif. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ont.*

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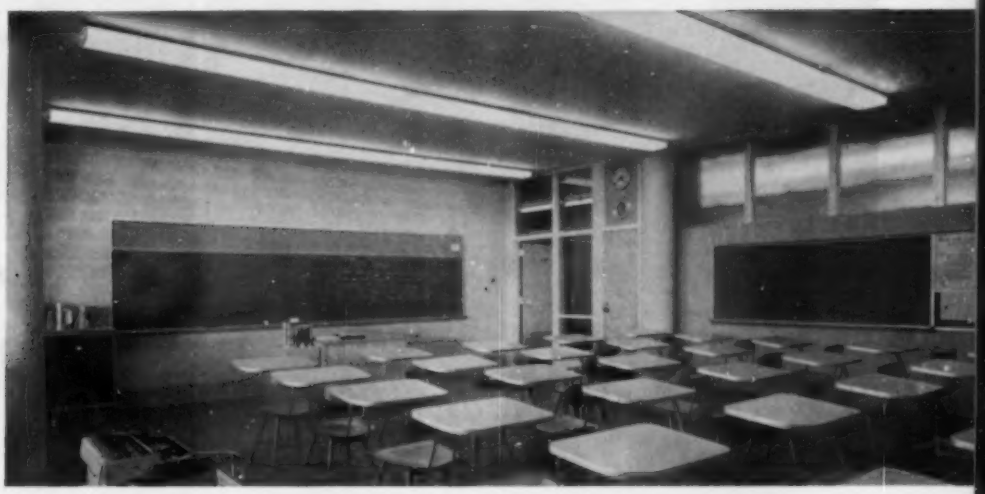
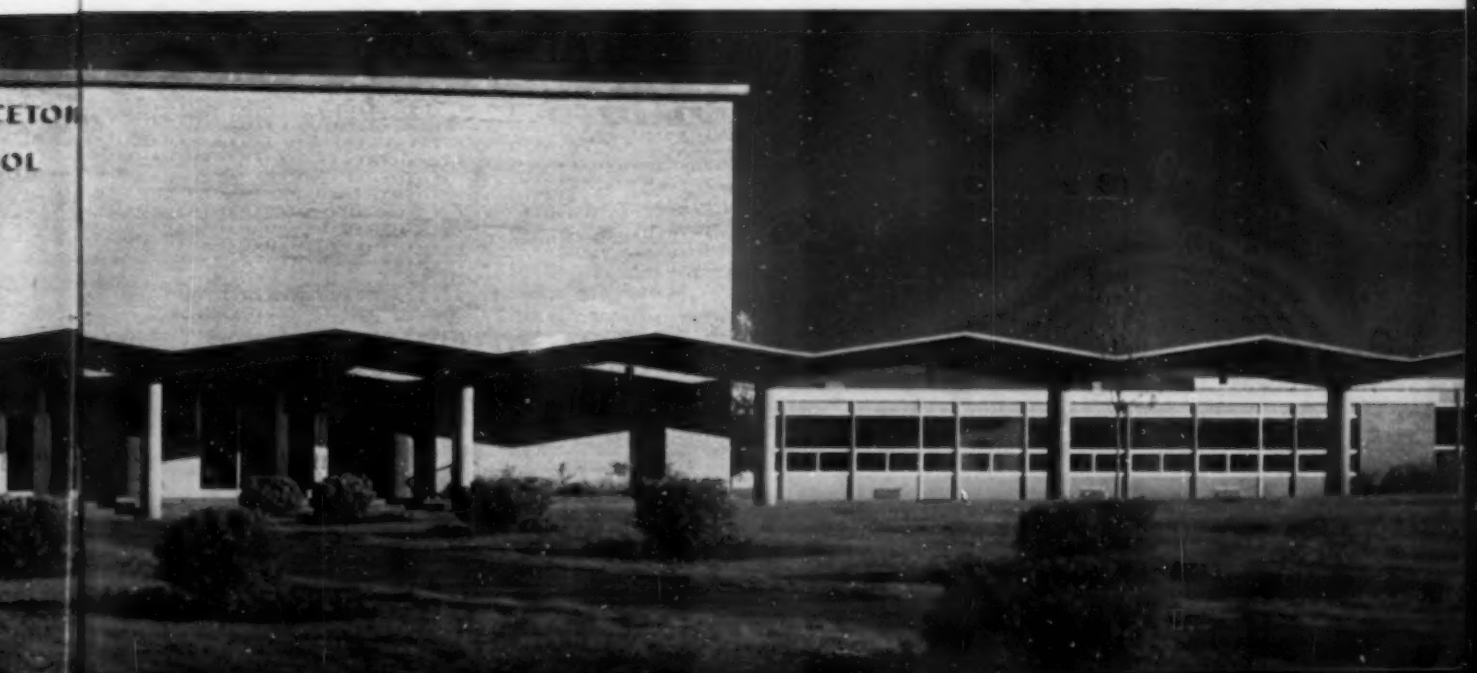
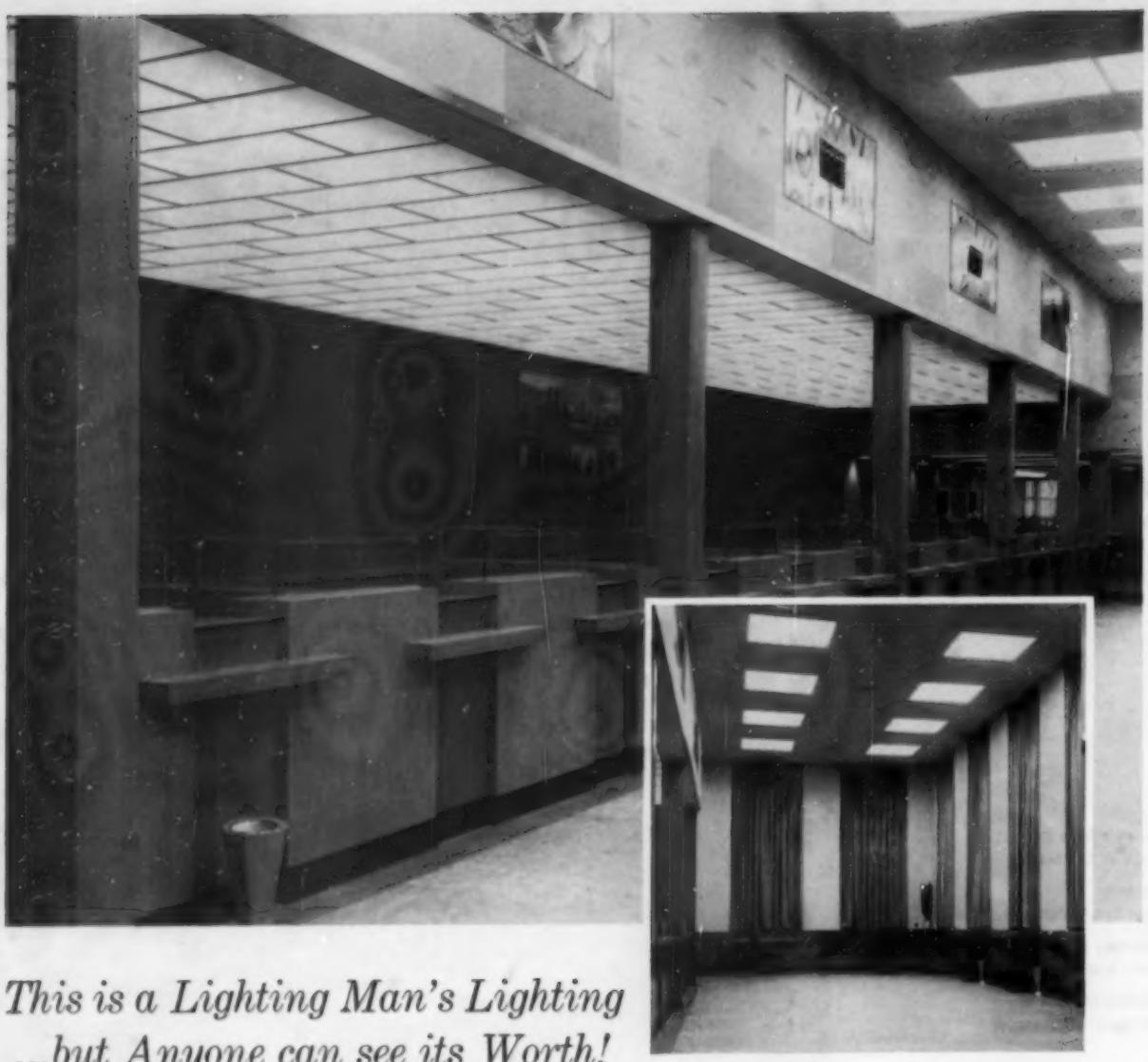


Molded acrylic plastic enclosures control light prismatically, eliminating glare.





This is a Lighting Man's Lighting ...but Anyone can see its Worth!

You *don't* have to be a lighting specialist to see that this lighting takes off where ordinary illumination stops. The photo of this bank interior shows clearly what happens when thoughtful building design and handsome functional lighting fixtures are combined. (And they usually are!)

The LITECONTROL plastic grid louvers used in both the luminous ceiling and in the four foot square recessed fixtures are molded of translucent polystyrene. This material is light stable, conforming to the IES-NEMA-SPI specifications for class C (ultraviolet light stabilized) styrene. Louvers are light in weight, show no dark shadows, and provide 45° x 45° shielding. Result: Maximum visual comfort as well as plentiful illumination . . . and where budgets are limited, the economical cost of the louvers is very welcome.

This application is typical of Litecontrol installations in commercial structures that control costs while providing peak lighting efficiency. May we help *you* on your next job?

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ARCHITECT: W. H. Jones & Son, Melrose, Massachusetts

ELECTRICAL ENGINEER: Martin E. Keane Associates, Boston, Massachusetts

AREA SHOWN: Tellers' Area and Public Area

CEILING HEIGHT: 12' — 0" in Tellers' Area; 18' — 0" in Public Area

FIXTURE: Tellers' Area, Litecontrol Luminous Plastic Grid Louver Ceiling, with 2' x 4' louver panels, rapid start strip fixtures on 3' — 0" centers.

Public Area, No. 4384-RS-PG plastic grid louver recessed fixtures, 4' x 4'.

INTENSITY: Tellers' Area, average 50 footcandles in service. On Tellers' counters, average 75 footcandles in service. Public area, average 75 footcandles in service.

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Fixtures

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DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

President's Report

By J. B. BROWDER
President, 1959-1960

ONE OF THE strengths of the Society over the years has been its continuity of service. From retiring boards, to their successors—from a committee, to its incoming personnel—from the officers, to the new administration. As I approach the end of my term as President of the Society it is my pleasure, in turn, to outline some of the year's major accomplishments, to indicate work in progress but not completed, and to venture my recommendations for future consideration. In the December 1960 issue of ILLUMINATING ENGINEERING a full report in greater detail, especially on the extensive committee program, will be made by the General Secretary, G. F. Dean. Your First Vice-President, R. G. Slauer, will report the Society's technical program (see page 459), and for this reason I will refer only generally to this important area of our program.

Society's Role in Research

In 1945, our Society saw the opportunity to strengthen the scientific foundation of the theory and practice of illuminating engineering through the establishment of a research agency. This independent agency, now known to us as the Illuminating Engineering Research Institute, has enjoyed the devoted service of many Society leaders. For the past several years, A. F. Wakefield has served as Chairman of the Board of Trustees of the IERI, and E. M. Strong as Chairman of the Research Executive Committee. Both are Past-Presidents of this Society.

The accomplishments of the IERI are a major interest of our Society. We eagerly follow its progress through annual reports from the Research Institute and all of us, of course, have seen the fruits of its work in the published reports of completed researches.

In the past five or six years, through the efforts of the IERI Trustees and their committees, excellent research projects and staffs have been developed at a number of universities in the United States and Canada. However, the success of these efforts was not matched with the necessary equal success in developing dependable and regular financial support for such continuing programs. The Trustees faced this critical situation in 1958 and since funds of the required magnitude did not seem possible through Society channels, they initiated a drive for funds through companies in the lighting field, as well as through organizations outside the lighting industry.

During this past year, inspired with the success of this "crash" fund-raising program, the Society completed a study through the Task Committee on Research Financing, with Kirk M. Reid as Chairman. Now, after many long sessions, and reams of correspondence, the Task Committee report is before us, giving significant guidance whereby the Society can now assume responsibility for continuation of the IERI program without interruption.

Substance of an address by the President before the National Technical Conference of the Illuminating Engineering Society, held September 11-16, 1960 in Pittsburgh, Pa.

Society's Role in the Profession

In my address before the 1959 Conference in San Francisco, and before all of the Regional Conferences this past Spring, I commented on the unique position of our Society in that it is creating a profession where one did not previously exist. In most phases of engineering, medicine, architecture and numerous other professions, the societies and associations serving them were established long after the recognized profession. To the contrary, in our field the Illuminating Engineering Society itself is slowly but surely *creating* the profession of illuminating engineering. Our Society establishes through its own work, a recognition of illuminating engineering as a separate profession. I would call to your attention that we are one of the few Societies which publishes a Handbook based on its own researches and technical committee reports.

Development of professional standards and the planning of educational programs are basic responsibilities of every profession. Our Society has developed and organized a wealth of engineering knowledge since 1906. This is presented in dozens of reports, hundreds of technical papers and is coordinated together in the *IES Lighting Handbook*. But we have yet to plan an educational program leading to the achievement of stated standards in our profession. This has been a subject of discussion by many Society leaders, and for many years our Committee on Professional Requisites strove to state a program for us to undertake.

This year the subject was one of two which I discussed at length with our membership at all the Regional Conferences. There is a strong interest among our members, so we are going to try again for a solution. With the full cooperation of the incoming administration, and subject to Council approval, we are establishing a Task Committee on Educational and Professional Standards. This committee will include several of the eminent leaders in our membership, who will undertake a study of the trend in educational and professional standards for illuminating engineering, consulting with all related committees of the Society. Finally, they will prepare a recommended course of action for the Society. An accomplishment toward this objective will go far toward establishing our position among the responsible societies in the engineering profession.

Disseminating the Society's Work

Second only to the *advancement* of the theory and practice of illuminating engineering in the Society's objective—is the *dissemination* of knowledge relating thereto. The Society has its first responsibility here in the communication of knowledge to its membership. The prime channel serving this objective is our distinguished Journal—ILLUMINATING ENGINEERING.

Since 1949 when extensive deliberation led to the expansion of our publication into its present form, the effort of the committees, officers and staff have been toward better serving the membership through the Journal. Because of its importance in reaching our own membership as well as thousands of architects, consulting engineers and others outside our membership, discussion has been continued as to means for a more effective use of the Journal pages. The Advance Planning Committee contributed to this thinking, and made a report on the subject at the first Council meeting last September in San Francisco.

During this past year, the Publications Committee and staff have made a special project of intense study in this direction. In addition to several all-day meetings devoted to ways and means for effective presentation of published material, they petitioned Council for extensive editorial research. With Council's approval this was undertaken last spring by a professional agency through the means of interviews in depth with a cross-section of the Society's membership. The results of this reader survey are being scrutinized for future guidance of the publications program. Steps for effective editorial presentation, specifically designed for greater value to the members, have been prepared by our Publications Committee. Positive action on these should result in valuable modifications toward our objective.

Parallel to the thinking about our publication, an extensive survey was made by a Task Committee with C. L. Amick, Chairman, on the long-range scope and operation of the National Technical Conferences. A series of suggestions and recommendations were developed by the committee based on questionnaire responses from a sizeable part of the membership. Important among these was the suggestion that more Conference programs be arranged to reflect the practical interest of the many lighting application practitioners in our membership.

Along the same line, another Task Committee under W. P. Graham, Chairman, reported late in the year its recommendation that a new Application Lighting Data Committee be established to serve the definite needs for such programs at the National Technical and Regional Conferences. Further study of these reports and their recommendations undoubtedly will lead to the improved services of our whole membership.

The dissemination of knowledge in the effective application of light sources and equipment to the

many important groups outside the Society, is a responsibility shared by every member. To the urgent direction given by many Presidents before me, I would repeat most positively this responsibility of every member to take "IES to the Public." Much is being done along these lines through the efforts of our national committees, national officers and staff. Well over 11,000 copies of the Third Edition of the *IES Lighting Handbook* are being used throughout North America. Every month copies of our publication ILLUMINATING ENGINEERING go to hundreds of subscribers all over the world, and to some 2000 key architects in the service areas of 32 of our Sustaining Member electric utilities. This year even more opportunities were found by our members and officers to bring the message of good lighting application to large numbers of local, regional and national organizations which share our interest in the advance of the art and science of lighting.

Expanding Society Membership

One healthy indication of interest in these expanding Society services is its ever-expanding membership. Full statistics on this will be included in the General Secretary's Report—but I would like to be the first to report that this year's growth broke the "10,000-member barrier" for the first time in the Society's history.

We have grown also in our structural strength. Our "branches" now reach out to 94 Sections and Chapters—and our "main limbs" to 12 Regions. Six new chapters were chartered by Council this year—Diablo, Gulf Coast, Northumberland, Kentuckiana, Illini and Housatonic. The twelfth Region was added with the division of our Midwestern Region (which embraced 16.3 per cent of our whole membership) into two divisions. These are now the North Central Region and the Midwest Region.

Our membership growth in recent years has turned the minds of your Council to the need for a careful look at our territorial organization. Continuing my analogy of a "tree" with branches and main limbs, we may need some judicious pruning or directed development. A Task Committee under the chairmanship of our Second Vice-President James R. Chambers has this project of territorial organization under study.

Society Structure

The individual member expects from his Society efficient and useful functions at all levels. This includes the Section and Chapter monthly meetings, and all the related activities. It includes also Regional Conferences, and finally the National Technical Conference. The individual member likewise expects the organization of top-flight committees for the effective administration of Society services. The elected officers of the Society are responsive to such wishes of the membership, and efforts never cease in the direction of improving organization and administration.

The chartering of new chapters is the basic step in Society organization. They offer the means for setting up Society meetings, lighting courses, and other special activities of direct service to the members. The Regional Vice-Presidents are key officers in their concern for effective local operation. A large part of their work through the Regional Activities Committee (headed this year by James R. Chambers, the Second Vice-President) is directed toward assisting Sections and Chapters with improved Guides, Manuals, personal visits and stimulation, to carry out the maximum program in each circumstance.

A fine development toward this objective has been Regional Organization Meetings, sometimes called Local Activities Meetings. These have been held each year in all the Regions of the Society. These valuable meetings bring together local officers and key committee chairmen with the Regional Vice-President for discussion of all parts of the Society program related to the Section/Chapter operation.

During 1959-1960 exceptional effort went into the planning for the nine Regional Conferences. Excellent technical sessions were offered, and opportunities for developing public relations were utilized. Careful studies were made as to the attendance and to the participation of all concerned in the Region. This is leading to further plans for improved service to all aspects of future regional conferences.

As mentioned previously, the whole territorial organization of the Society is under study. The establishment, this year of a twelfth region is an initial step toward better organization of service to our members, but this whole area of Society structure is of concern to the national officers. Such Committees as Advance Planning have included in their discussions, a review of the make-up of our National Council, and the relation of our national officers to the Society's whole national committee structure.

Society Headquarters

At the close of our last fiscal year the Society took an action of far-reaching importance. It decided that we would associate with the other major engineering societies which will have headquarters offices in the new United Engineering Center, located on the United Nations Plaza in

New York City. This modern office building, to which our headquarters will move in 1961, should provide excellent facilities for modern office operation. We will have the benefit of first-class offices in a mortgage-free building, recognized as a center for the cooperative interest and effort of over a quarter million members of the engineering profession. In this year, I have been privileged to attend both the ground-breaking ceremony on October 1, and the laying of the cornerstone on June 16. Other leaders of our Society joined with me and representatives of the constituent societies in these celebrations. July 26 was another significant date. The topping ceremony was performed, celebrating the setting of the final piece of steel in place at the top of this 20-story structure.

Along with the advantages of occupying space in the new Center, we share in the obligations—in the management of this building, and in the raising of funds to make this structure mortgage-free. Since last Fall, I have had the assistance of all the Sections and Chapters, as well as a special committee of 25 Society officers and leaders in securing contributions from our members. Our combined efforts to date have collected about one-fifth of the $75,000 quota we elected to try for. Only two of all the engineering societies have achieved 100 per cent of their quota, so the drive goes ahead toward raising the total needed. Once the job is done, we will take a proud place with the other leaders of the engineering profession, as we join with them in our new Center.

For Future Consideration

I have mentioned earlier in this report, the Society's role in the profession of illuminating engineering and the steps being taken for an educational program within the profession. I would now like to propose for future study, a revival of our most effective program for the education of the public—their education in some of the principles of good lighting, and their education in the existence and aims of the Illuminating Engineering Society. I refer to the certification of equipment program this Society conducted between the years 1934 and 1944.

Subject to Council's agreement, I propose that a study be made of the feasibility of a similar "certification" of luminaires tied in with future editions of our *IES Lighting Handbook*. Should Council consider such a program a suitable undertaking for our Society, no doubt its many details would be worked out. Some of these, I realize, might be quite difficult and the many problems associated with such a program may be quite complex. However, my own "rough draft" of the proposal which was introduced initially at all of the Regional Conferences, was along the following lines:

The label affixed to the luminaire might read "IES Type A-3. This luminaire design is approved by the Illuminating Engineering Society for uses described in the *IES Lighting Handbook*, indexed under IES Type A-3." The Handbook, not being restricted by space limitations such as would be the case if one tried to put all the information on tags on the equipment, could deal at length with the general types and their general and specific uses. For example, the office lighting committee could select from all luminaire types available, the various particular luminaires suitable for office lighting use.

My suggestion was that the certification would emphatically have nothing to do with physical quality any more than photometric data reports of a testing laboratory have to do with physical quality. This, I suggested, should be so stated both in the *IES Lighting Handbook* and on the certification label.

As outlined in my initial proposal, it might be possible that certain types of luminaires would come to be known as "IES Type 12," "IES Type 6-A," etc. We are almost doing this now, without the labels, in street lighting equipment. All street lighting manufacturers make luminaires with distributions conforming to, and designated as, IES Types I, II, III, IV and V. The Roadway Committee has already done, to a large degree, what my proposal advocates for the rest of the industry. The Roadway Committee worked out the needed distribution patterns, cut-off angles, and other characteristics, and set them up as standards for the industry to follow. The industry followed these standards.

Such a "labeling service," I realize, is fraught with problems. Perhaps a study would bring to light many valid reasons why the Society should not undertake it. However, as a possible service to the public, service to the industry and service to the public relations of the Society, I sincerely suggest that it be considered.

Conclusion

When I started the responsibilities of this year, I promised to do the best job I know how to do. This I have done. Now, twelve months later, I only wish I could have had more time and more energy to put forward all the projects on which we worked together. We have made progress. There are many, many tasks in process—I will join with you all in continuing to put my best efforts toward their completion.

Report of the President-Elect

By R. G. SLAUER
President, 1960-1961

A REPORT by your president-elect is not a requirement at the annual meeting and hence my place on the program is both a challenge to me and a reflection of the deep interest that so many of you have in the Society as an effective force in lighting. My remarks inevitably must be a summary of those activities which helped me to qualify for consideration as your presidential nominee as well as a forecast as to how I will try to justify the honor you have bestowed upon me by making me your president-elect.

The dramatic word in our Society for the past few years has been research—a field of activity not to be ignored or taken casually. Research is the continuing effort guaranteeing that tomorrow's horizons will always be brighter. But there is also today, when a planned effort must be made to understand and interpret research, to disseminate and apply the knowledge stemming from research, to design and build the products which make such knowledge useful—in short, to recognize engineering for its important part in any trend toward the better life.

The trustees of the Illuminating Engineering Research Institute have recognized this distinction between research and engineering and have placed their emphasis on what is popularly termed pure research as against application-oriented research or application itself. I very much agree with this policy—but I would be remiss if I did not point out that this leaves a burden which the Society must assume. Research can be absorbed into the operating stream of a profession only by specific effort; research can be applied successfully only with the understanding and help of those experienced in the field; research may temporarily create more problems than those it helps solve; research in itself seldom supplies "final" answers.

Nuclear energy and missiles are examples of the broadness required in modern technology; here in Pittsburgh a better example is the Salk polio vaccine. Even after Dr. Salk's dramatic announcement, it took several years of work by many doctors and many manufacturers to make this program successful in the truest sense. No one can estimate the time and money required to apply the knowledge resulting from the outstanding research of Dr. Salk, and even as we applaud this success, research is already suggesting newer and better techniques.

This leads to a question which I will pose for your consideration. Has the Society accepted the challenge presented by the brilliant work of Dr. Blackwell? I don't believe it has. As in a relay race, Dr. Blackwell has run to the point in the race

Substance of an address by the First Vice-President before the National Technical Conference of the Illuminating Engineering Society, held September 11-16, 1960, Pittsburgh, Pa.

assigned to him—it is our turn to grasp the baton and run our part. If I am right, this analogy is very appropriate. Individual brilliance in a relay is not pertinent—*everyone* must finish his assigned part.

Let me discuss a few specific technical activities of the Society. The first relates to the work of the Roadway Committee. Perhaps you will remember that Dr. Blackwell's work applied to interior illumination only. It had been hoped that his findings could be translated readily into outdoor concepts; more than a year's work by your Roadway Committee with Dr. Blackwell has not provided the necessary knowledge and application experience. Hence our hoped-for new Recommended Practice for Roadway Lighting was not completed during the past year. I do not say this in any sense of regret or criticism—I want to compliment all members of this Committee for their insistence on an "I'm from Missouri" attitude which this year or next will guarantee a Practice completely worthy of the Society's backing. There is, of course, the possibility that the IERI trustees will decide that this activity constitutes application work and will assign Dr. Blackwell to other matters. Such a decision has much justification; we, therefore, must see that a decision of this nature spurs us on rather than discourages us.

Let me point out two related facets which apply to other fields of lighting as much as to roadway. One of the developments which made Dr. Blackwell's conclusions possible was the Visual Task Evaluator. If I am correctly informed, this instrument is still a research laboratory tool—not a single one is in the hands of those who sell or apply lighting, those who design or develop equipment, those who work on Society committees. It may not be the type of instrument that everyone wants but we all need the verifications which it can produce. You as individual Society members might insist that your Council take the lead in this; perhaps, for example, by purchasing two or three instruments for your Technical Office so that they may work directly with your application committees and on special investigations.

A second facet is the Field Factor, Dr. Blackwell's link between laboratory and field. To the extent that field factors are developed from reasoning and logic rather than from facts, and because a single Factor (15) has been chosen as generally representative of all lighting tasks, it is reasonable to assume that it cannot apply accurately to more than a few tasks accidentally at the center of a vast complex of relationships. The work of the Roadway Committee dramatizes this. If 5 APS (assimilations per second) is valid for miscellaneous tasks, in the development of FF 15, what is valid for driving on a highway at 65 miles per hour? My own conclusion is that we should use the highest possible APS value — Dr. Blackwell suggests that this would be 30 which would multiply FF 15 several fold.

Do we have any other seeing task any more critical than vision on highways? It is one of the very few which to each of us has the direct challenge of 5000 footcandles and five-tenths. It is one of the very few which to each of us poses the question of our own life and the lives of others. It is one of the very few which forces us to understand and act in a very small fraction of a second from information obtained from the whole visual field. I am afraid Dr. Blackwell's ultimate conclusion, within the same frame of reference as his recent general work, would lead to a recommendation of 100 or even 500 footcandles. Possibly we are not ready for this economically, psychologically, or practically. This places the necessity of compromise squarely up to our Roadway Committee, a group in which I have unlimited confidence for technically competent judgment.

I must also report to you that the long-awaited Recommended Practice for School Lighting is not yet ready. Hopefully it is just around the corner—it may be submitted and accepted by Council by Friday of this very week. Since our last Practice is dated 1948, you have a right to ask—why the delay? Here again I would urge pride rather than criticism. John Chorlton and his committee feel, quite properly, that they must be right within any reasonable scope of interpretation.

In addition to some of the points brought out above, Dr. Blackwell's method as applied to the recommendation of improved school lighting requires an interpretation of the phrase "quantitative method." We can measure output in many things but there is no agreement in the field of learning. The fact that Johnny reads faster or better than Billy is not a measure of learning or of education. As you well know, even Johnny's possible better grades at the end of the year are not accepted automatically as a measure of better learning. We might agree that higher-level lighting provides a better opportunity for every student but educators and architects have been slow to put as much importance to this viewpoint as we do, particularly above what has been currently accepted during the past five years. This might be a case where the logarithmic steps required for significant improvement in vision militate against easy acceptance.

The philosophy I propose to follow during my administration is based on the following summary; I hope it will appeal to everyone in the lighting profession:

(1) Support fundamental research to the utmost.

(2) Recognize and help supply the considered engineering judgment and work needed to utilize the products of research.

(3) Actively help the Society in its efforts to disseminate engineering knowledge to its members and to the public.

I have not followed a basic rule of public speaking by taking so much time in discussing what did *not* happen this past year. I hope you will understand. For the record, however, let me now say what *did* happen; things for which we are all grateful to hardworking technical committees and the technical staff at Headquarters. These include:

(1) A new Recommended Practice for Office Lighting, revising the one approved in 1956, just before so many related researches became available for consideration.

(2) A new Report on Church Lighting, an outstanding contribution in a field in which all too frequently esthetic or economic considerations obscured visual considerations.

(3) The second of a series of reports on plastics in the lighting field—"Recommended Light Characteristics of Acrylic Used in Illumination."

(4) A report for a growing use of light for the leisure we as a civilization are developing—"Current Recommended Practice for Sports Lighting."

(5) A report "Lighting — Keyed to Today's Homes" whose very title is a reflection of the need for keeping this oldest application of artificial light always current.

(6) A "Recommended Practice for Airport Service Area Lighting," a recognition of the great change in public transportation in the last 20 years.

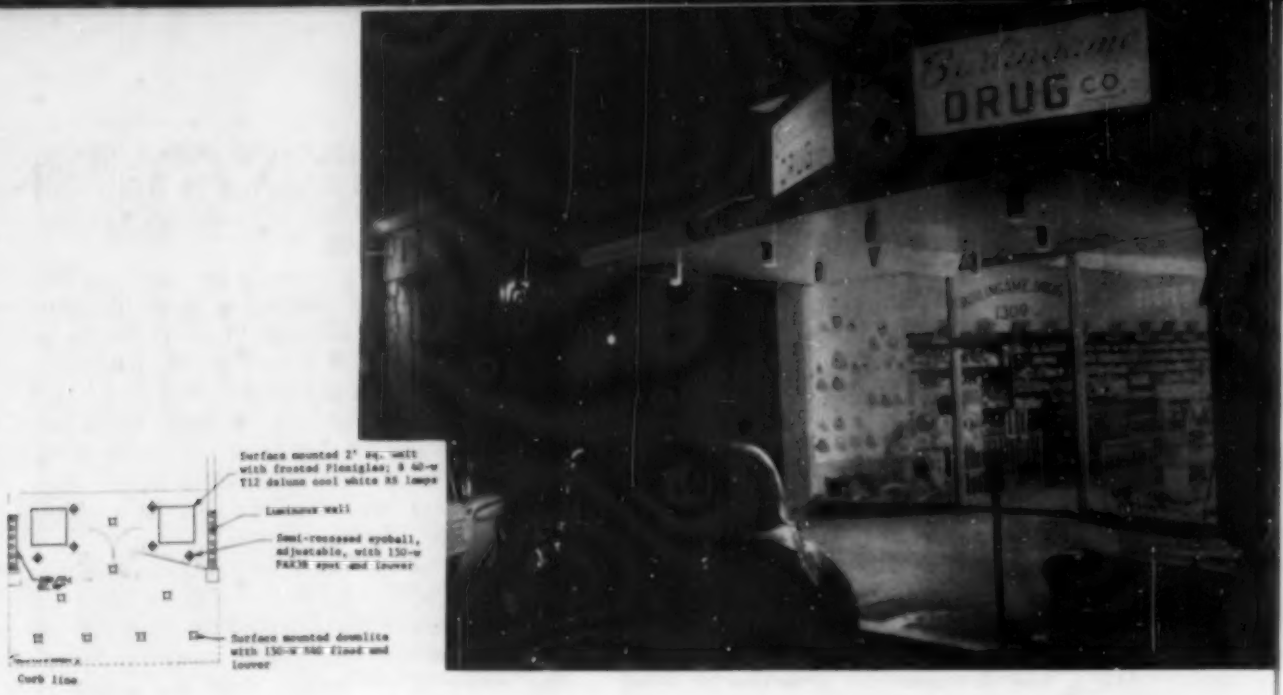
In my work with technical committees, I have become convinced that better coordination and clearer direction is needed in the dissemination of their work to both our members and to the public. I expect, therefore, to apply extra effort as president to the related problems. Each time I review this pledge to myself, I am more impressed with the broadness of the undertaking. Our technical work is a key factor in our publications program which on the surface is the single most important activity in the Society — an activity which costs more money than any other but which produces more revenue, an activity which involves more people of our staff than any other, an activity which in the truest sense is the only positive contact with every member, systematically and frequently. But the publication program—IE and all related material—is not basic in its own right; it is important primarily as the best way to disseminate technical knowledge and progress.

Our technical work is also a key factor in our national and regional conferences, in our monthly Section and Chapter meetings. It is a key factor in our challenge to those in our schools who must some day be our successors in all fields of lighting. And all this leads to a single key conclusion which can be given an easy identification but which is so broad that the identification hurts rather than helps. This key conclusion—the need for a sound, expanded public-relations system.

Every one of the recent Society presidents has emphasized the need for such an activity. Little has been done because the programs proposed did not have broad or universal appeal, there was insufficient money in our budget, there was a lack of urgency, or all three. I will try hard in the next 12 months to meet this challenge and to implement the suggestions of Joe Browder, of George Taylor, of Kirk Reid, and of many other predecessors.

P. R. and I—as we call it—is not a question of publicizing the fact that you elected a new set of officers, that you are going on a boat trip next Wednesday. These have their place but it is a small place. We must create the image of what the Society actually is and does to lead lighting progress, to develop human resources, to make people happier. From this image we will find the support for an even greater research program, even greater interest in lighting application, even greater respect for the profession of lighting. I believe our National Conference should be a meeting at which we speak among ourselves, we examine ourselves and our fellow members, we criticize ourselves, we try to understand our sometimes conflicting viewpoints. But at almost every other meeting—local, regional or national—and through all printed material including IE, we should share our efforts with the public; we should see that the public understands to the fullest extent what good lighting is, what it means, what it does. All this cannot be done by wishful thinking—it will take planned efforts to create the symbol of IES—not the insignia but the idea behind the symbol—in the minds of 20 million Canadians, 175 million Americans, and countless other millions throughout the world.

I hope you will support me to the fullest in this attempt to orient the Society's purpose and actions to facts as they face us in this changing period of human experience and interest. Thank you in advance for giving me the opportunity to try during the next year as your president.


DRUG CO.
Surface mounted 2' sq. unit with frosted Plexiglas; 8 40-w T12 deluxe cool white RS lamps
Luminous wall
Semi-recessed eyeball, adjustable, with 150-w PAR38 spot and louver
Surface mounted downlite with 150-W R40 flood and louver
Curb line

Dramatizing an Open-Front Store

In Burlingame, California, one store stands out from its neighbors like a beacon in the night. The phrase is apt; it has beckoned some 20 per cent more business since remodelling and emphasizing its new look with lighting.

Levels, of course, are high in this quick-turnover drug store sales area. But the feature which attracts immediate attention is unique walls of light on each side of the open-front store. These luminous walls extend six feet back from the angled windows on either side, eight feet high. Essentially they are luminous "boxes" recessed 12 inches into the wall, each housing six 48-inch RS deluxe cool white lamps on 12-inch centers. The lamps are two in tandem to each dimming type ballast. Diffusing panels are of Plexiglas. Controlled by dimmers, for varying brightnesses during different times of the day or night, maximum brightness is 350 footlamberts at 90 degrees. This limiting brightness, uniform from edge to edge, is an important factor in the success of the idea.

Additional punch is given to the entrance by two ceiling mounted four-foot square fixtures, one over each front corner of the entrance. These use eight 40-watt RS deluxe cool white lamps in each unit, on 6-inch centers. To accent "leaders" or special displays, six eyeball spots lamped with 150-watt PAR spots are grouped around the two ceiling panels. Further, eight 150-watt reflector lamps in surface-mounted decorative cans are mounted on the marquee and over the entranceway to the store. These flood the sidewalk with a pool of light.

As it turns out, this is not just another lighted window. Several merchandising advantages have accrued from the particular techniques used, in addition to emphasizing the open-front store.

- The high levels (up to 510 fc) concentrated in the store front compete successfully with daylight, minimizing the window reflections.
- Vertical lighting component almost doubled.
- Spill light through the open front and from the lighted marquee brightened the entire street after dark—in the area of this particular store.
- The luminous wall was "different"—itself attracting attention both from outside and inside.
- Merchandise on shelves in front of the luminous walls was silhouetted where solid, and lighted through where translucent—a most attractive display of color and form.
- New repeat customers have been added to the owner's records—undoubtedly a result of their favorable impression of the store.

Lighting design is by John M. Gill and C. W. Macy, Pacific Gas and Electric Co., San Francisco. The installation took third prize in the IES Golden Gate Section's Applied Lighting Competition.

An ingenious ceiling "mural"—simply a planned pattern of painted colors—has been used to offset high ceiling brightness in this indirect system using high-output lamps in a low-ceilinged store. The idea is worth filing, for similar low-ceiling lighting problems.

IDEA FOR . . . .

Control of Ceiling Brightness

THERE'S AN interesting challenge in applying new light sources to old situations. The challenge is in solving any *new* problems created—as well as in introducing fresh lighting techniques. The extra-high-output fluorescent lamps, for instance, offer bright new possibilities for many areas. They offer new problems too (also bright!) especially in relatively low-ceilinged retail areas. The answer lies in brightness control.

Just such an application of high-output lamps, and the solution for control of their brightness, is the one illustrated here. It is a sales area of the Coral Shop in Grand Rapids, selling infants', children's and women's casual apparel and accessories. Main sales space is 36 feet wide, 22 feet deep, with an alcove for infants' apparel and a fitting room extension for a total of 970 square feet.

General lighting is supplied by only six 96-inch extra-high-output lamps in specially designed wood troughs, and 14 incandescent downlights. Particular displays are highlighted by a few other supplemental incandescent accent spots; chandelier is for decorative effect only. Total wattage, including show case lighting, ballasts, *et al.*, is 3500 watts, or 3.6 watts per square foot.

With a ceiling height of only 9 feet 10 inches, and an 18-inch hanging height for the luminaire, there was, of course, a brightness problem. The brightness of the near-white ceiling was 180 footlamberts, creating a distracting glare. Further, this brightness on the ceiling fell off to 12 footlamberts five feet out from the unit.

To reduce this brightness, an abstract ceiling "mural" two feet nine inches wide was created, with colors in the center having a reflectance of 45 to 57 per cent, increasing to 76 per cent at the outer edge. This decreased the brightness accordingly to a maximum of 100 footlamberts in the center to 85 at the outer edge adjacent to a ceiling brightness of 100 footlamberts. Gray wall tones averaged 60 footlamberts. The colors used in the ceiling repeated the two basic hues used in the general decorations, a dull rose and bluish gray. This harmony was an important part of the visual effect. The color of the ceiling over the indirect unit ties in with, and becomes an integral part of, the basic color design.

Table I lists six tones in ceiling mural giving Plochure number, Plochure name, Munsell notation and name given by ISCC color names committee. (Plochure color cards were used as samples by the painter.) Fig. 1 shows plan of mural with Plochure numbers designated thereon.

TABLE I—Ceiling Mural Tones

Plochure Number	Name	Munsell Notation[1]	Approximate Reflectance Per Cent	ISCC NBS[2] Color Name
373	Evening Haze	3.5R 6.7/5.3	45	Moderate Pink
382	Silver Pink	6R 7.5/2	57	Grayish Yellowish Pink
383	Rose Pink	6R 8.2/2	62	Pale Yellowish Pink
693	Fidelity	5.8PB 7.6/4.5	58	Very Pale Purplish Blue
710	Zephyr Blue	6.5 PB 7.5/2	65	Pale Blue
687	Winter Sky	4.BP 9/0/3	76	Very Pale Blue

1. The Plochure Color System. A Descriptive Analysis by W. E. Knowles Middleton. *Canadian Journal of Research*, January 1949.
2. From report of ISCC Subcommittee on Problem 2, Color Names, Deane B. Judd, Chairman.

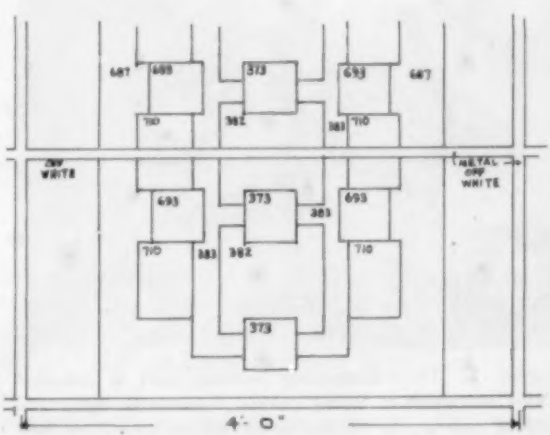


Figure 1. Plan of mural, with Plochure numbers.

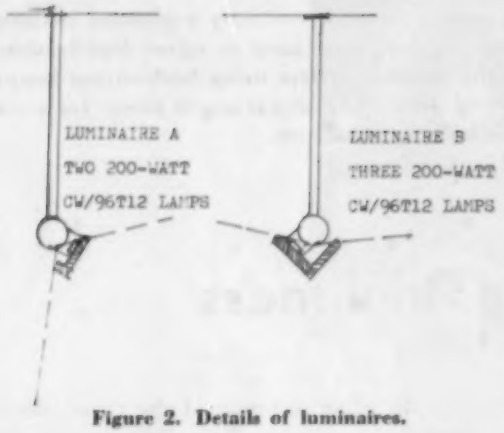


Figure 2. Details of luminaires.

Figure 3. Wall equipment carrying women's sportswear and accessories. Photograph accents the brightness of the ceiling which, to the human eye, does not appear relatively as bright.

Details of the luminaires are illustrated in the drawing, Fig. 2. Luminaire A, on the left, is a two-lamp trough used on the wall fixture side. (It can be seen in the photograph, Fig. 3.) In addition to the indirect up-component of this unit, a direct down-component illuminates the top of the show cases to an initial level of 90 footcandles. The lamp, however, is shielded from the space used by the customer.

Luminaire B in this drawing (Fig. 2) is a unit three lamps long having a totally indirect trough. It is used primarily for general lighting in the three combination sales and fitting rooms. There are supplemental 75-watt spotlights on the side of the mirror which are directed to the garment on the customer. This unit can be seen in the photograph, Fig. 4.

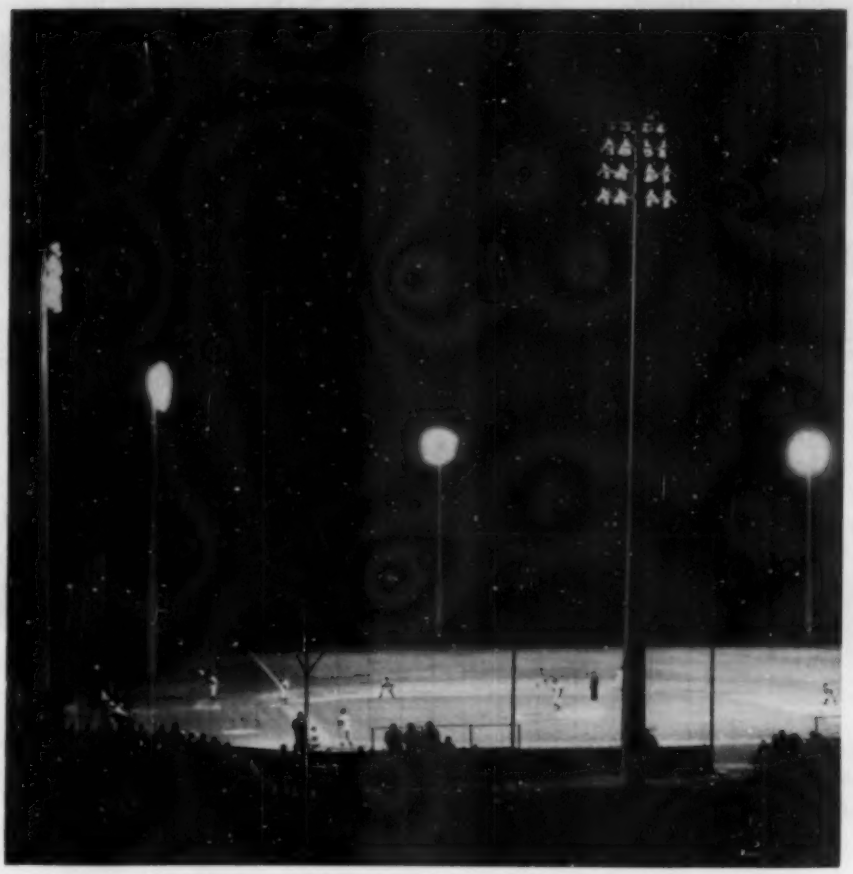
The Cherubs' Corner, which features infants' wear (Fig. 5), has general illumination provided by one 96-inch high-output lamp placed behind the valance, in addition to four 75-watt spot accent units which are directed to the side walls. Initial illumination here was 85 footcandles on top of the counter.

While appraisal areas such as the top of the counters and show cases, and the fitting rooms, had high levels of illumination, the main central area averaged a relaxing 25 to 35 footcandles. Remote ballasts are located in partially soundproofed, but ventilated, boxes located above the furred down acoustical ceiling.

The lighting design is by Kenneth C. Welch; Interior designer was Lila M. Welch; both are of Grand Rapids, Mich.

Figure 4. Three-lamp-long indirect unit is installed above entrances to fitting rooms. Removable acoustical ceiling panels are 24 inches by 48 inches. Note how contrast in brightness calls attention to merchandise.

Figure 5. The Cherubs' Corner—layette and infants' wear department. The door to the right leads to the back work space and office; door to the left leads into a large, concealed stock room.



INSTALLATION AT HEIDELBERG PARK, TACOMA, WASHINGTON

Lighting a Baseball Field

LIGHTING OBJECTIVE: To provide illumination for nighttime playing of semi-professional, municipal and recreational baseball.

GENERAL INFORMATION: This field, shown in plan in Fig. 2, is part of a large recreational park which contains facilities for basketball as well as baseball. It is one of the newest lighted baseball fields in Tacoma and has been called the best lighted field in the Northwest with the exception of the Pacific Coast League Parks.

INSTALLATION: Seventy-six Crouse-Hinds Co. type FLA catalog No. 44429D (class GP, type 5) and sixty-eight type FLA catalog No. 44428D (class GP, type 4) floodlights provide 42 footcandles at home plate, 36 on the pitcher's mound, 22 to 25 on the infield base paths and 15 in the outfield. Each floodlight is equipped with a 1500-watt PS-52 incandescent lamp burned at 10 per cent over rated voltage for increased light output.

There are 16 floodlight units each at pole locations 1 and 8, 32 units each at locations 2 and 7, and 12 units each at poles 3, 4, 5 and 6. (See Fig. 2 for pole locations.) These units are installed 70 to 79 feet above the field level on 1½-inch aluminum pipe crossarms mounted on pre-stressed

(over)

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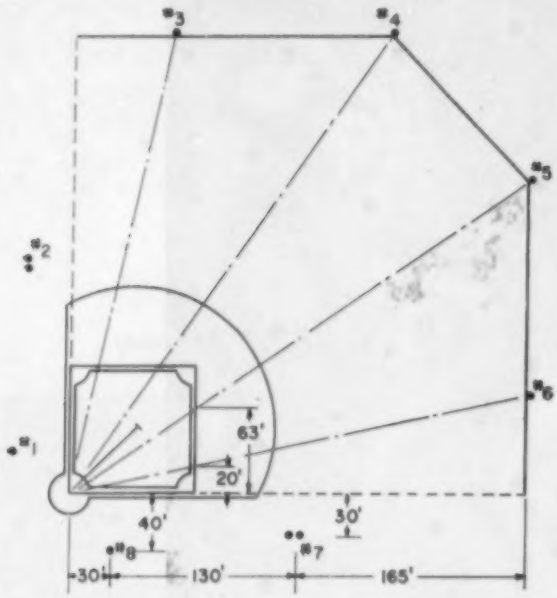

Figure 2. Plan view showing location of poles.

Figure 3. Daytime close-up of poles and floodlights.

concrete standards furnished by the Concrete Technology Corp. of Tacoma, Wash. (See Fig. 3) The standards which are 80 feet high, are hollow 60 feet up with space for both primary (4160 volts) and secondary wiring.

Lighting designed through cooperation of Tacoma Park District personnel, Crouse-Hinds Co., Paul Marten, registered electrical engineer and Graybar Electric Co., Inc. Contractor was Carl T. Madsen, Inc., Tacoma, Wash.

Lighting data submitted by Eugene M. Dorman, Litecraft Mfg. Pacific Corp., Seattle, Wash., as an illustration of good lighting practice and to aid in the design of similar installations.

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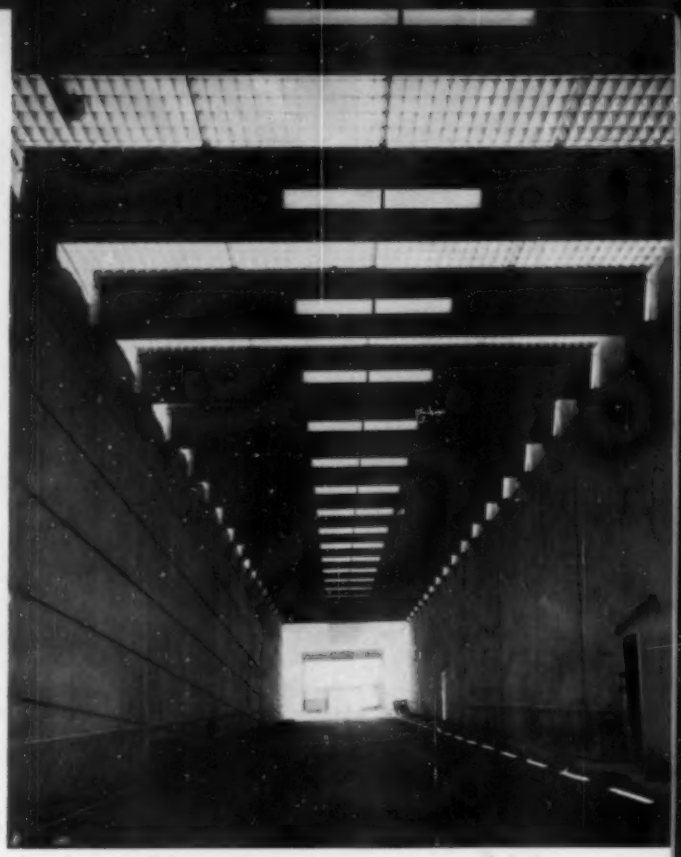
Deas Island Tunnel has been built for the British Columbia Toll Highways and Bridges Authority to provide a crossing of the lower Fraser River near Vancouver. It is of rectangular cross section, the subaquaeous portion, 2400 feet long, and contains four lanes for traffic, divided by a concrete center wall. The tunnel has been built by the trench method, i.e., six elements have been constructed in a drydock, each 340 feet long, 75 feet wide and 25 feet high, in order to be floated into place and to be sunk into a prepared trench. Some of its lighting problems and their solutions are described.

DEAS ISLAND TUNNEL

By KARL HASELSTEINER



Louvering system at exit. Similar transition at entrance is louvered for first 300 feet.

With most installations, the criterion for good lighting is the nighttime effectiveness. In tunnel lighting, quite the contrary. Our problem is the clear sunny day when something like 10,000 footcandles may illuminate the highway. It is then that the tunnel, no problem at night, becomes a sinister dark hole.

It is this effect, of course, which has established the lighting principles for tunnel installations—and most of the design problems. Chiefly, they hinge on the transition from bright sunlight to much lower levels within the tunnel, this transition having to take place at speeds much greater than the eye requires for adaptation. In fact, the sudden contrast is so great as to cause momentary blindness. In the Deas Island Tunnel we have provided for this adaptation quite successfully.

Increasing the illumination inside the tunnel to match outside levels is an insurmountable economic barrier. However, decreasing these outside levels to provide a gradual transition at the entrance and exit has been a successful solution in many tunnel installations. In our tunnel, 300 feet of louvers at the entrance and 180 feet at the exit provide for a smooth transition between the outside daylight and the tunnel entrance light. Even with a speed of 60 mph, ample time is given for the necessary eye adaption. Even at 80 mph it would take more than two seconds to pass underneath the louvers. This is still a safe adaptation time for most eyes—though hardly a safe speed for entering tunnels!

The louvers, made of anodized aluminum, are precisely tilted at such an angle that under no conditions will direct sunlight reach the roadway underneath. In addition they provide a certain amount of draft, supporting the artificial ventilation and eliminating the accumulation of dust particles at the portal which could cause an uncontrolled amount of veiling glare.

In the design of most tunnels, the approach has been to admit as much daylight as possible through the portal. In the Deas Island Tunnel, however, the tunnel entrance has exactly the same cross section throughout. From the louvered entrance (where the level is about 85 footcandles) throughout the length of the tunnel, our contrast ratio is less than ten to one. As the driver becomes adapted, in his journey through the tunnel, he encounters a gradual decrease of illumination to 10 footcandles

At the time of writing, the author, now a consulting engineer, was attached to the Joint Venture of FENCO and Christiani and Nielsen (Canada) Ltd., designers of the tunnel.

At right, top—note smooth transition from daylight to tunnel lighting. At right, interior of tunnel. Above, approach lighting.

700 feet from the entrance. Farther into the tunnel, after complete adaptation to night driving, the level is 5 footcandles, which is quite satisfactory for this condition. The process is reversed in his trip to the exit, where readaptation to outside daylight conditions is provided by the louvers at the exit. The use of such louvers, which allow for considerable savings in operating costs, was first proposed by Romaine W. Myers in 1939.

No problem arises under nighttime conditions and the illumination, controlled by photocells outside, follows automatically the day and night cycle, in all seasons. Further provision is made to cut down on operating cost during periods of extremely low traffic volume. To achieve this the experienced traffic pattern is stored in a memory device, which superimposes its command to the previously mentioned outside light cycle.

The lighting can be controlled manually or automatically. In the latter case, the system provides automatic adjustment for differences in daylight levels and traffic volume and safeguards itself against sudden blackout to avoid possible accidents and driver hysteria, by switching over to an emergency source.

Careful consideration was given to the luminaires used for this installation, in the interest of trouble-free efficient operation. Conventional street lighting luminaires are not suitable for tunnel lighting. Such fixtures are designed to concentrate light on the roadway from a high point, where no side illumination is required. In a tunnel it is desirable to illuminate the sidewalls to offset the tendency of driver to stay in the center of the roadway. The importance of lighting the ceiling is certainly less than commonly believed. If the ceiling is the source of light and not the limit of sight, the feeling of being enclosed in a trough is less pronounced.

More than 700 luminaires were required for this installation. They were chosen especially to be waterproof, well constructed, with removable ballast and to have reflectors of not less than 80 per cent reflectance. Two types of fluorescent lamps are used; a lightly-loaded 430-ma slimline lamp, and for part of the entrance, a highly-loaded 800-ma lamp. The highly-loaded lamp was chosen not only to provide the required footcandle value, but also to provide more uniform brightness under low temperature conditions. Light output decreases about one per cent for each degree drop in bulb temperature below 100F, but the highly-loaded lamp shows less change in output with temperature changes. Inside the tunnel a more uniform temperature will be maintained, close to the ambient of 80F, with bulb wall temperature of 100 to 120F.

For maintenance of the installation, a group replacement of the entire tunnel has been recommended when 20 per cent of the lamps are burned out. With a 7000-hour life expectancy for these lamps, an operating life with this group replacement system is expected to be 5000 hours or better.

Come-Back for Downtown Sales

THIS remodelled shoe store in a very old building in downtown Cedar Rapids, Iowa, is one of the forerunners in the trend to re-born downtown sales areas. Lighting was a predominant factor in the modernization, with all the decorative features of the newest suburban buildings. To wit:

- Show window lighting punched up to 150 fc. This is from ten elliptical reflectors using 300-watt R40 lamps; 17 recessed units with gimble rings using 150-watt PAR38 floods or spots.
- Coves, shadow boxes and concealed uplight for general lighting and pleasing background effect.
- Recessed ceiling units arranged in pleasing patterns, integrated decoratively with air-conditioning outlets. These are in six-foot square panels made up of 4 two- by four-foot troffers with diffusing plastic shielding. In each troffer: two 40-watt T12 deluxe cool white rapid-start lamps.
- For the viewing of shoes, light on the floor; 50 fc average provided at shoe level by recessed elliptical reflectors with 150-watt and 300-watt R40 floodlamps.

Lighting design by J. Charles Young, Iowa Electric Light & Power Co., Cedar Rapids, Iowa, took first prize in Iowa Section's 1959 MMILJ contest.

INSTALLATION AT FREE PUBLIC LIBRARY, HUDSON CITY BRANCH, JERSEY CITY, N. J.

Lighting a Library

LIGHTING OBJECTIVE: To provide general illumination and a comfortable environment for reading and writing in a library.

GENERAL INFORMATION: The reading room and shelf area shown above measures 46 feet wide by 44 feet deep in the foreground portion and 34 feet wide by 19 feet deep in the rear portion. The ceiling height is 12 feet. Colors and reflectances of the major room surfaces are:

ceiling	white	acoustic panels	80% RF	floor	tan	40% RF
walls, side	white	acoustic tile	80% RF	table tops	blond	60% RF
rear	gray		50% RF	bookcases	walnut	30% RF

INSTALLATION: Fifty-two Day-Brite Lighting, Inc. catalog No. 4G495-4 fluorescent troffer units, each equipped with a plastic lens bottom and four 40-watt T-12 cool white rapid-start lamps, provide an average illumination level of 95 footcandles at table height. All units are installed in pairs to form 4-foot squares. In the foreground portion there are 20 squares (40 units) arranged on 12-foot centers across the room and on 8-foot centers down the length of the room. In the back portion there are six squares (12 units), also arranged on 12-foot centers across the room and on 8-foot centers down the length of the room.

Vertical illumination at the wall bookshelves varies from 50 footcandles 6 feet above the floor to 25 footcandles at the bottom shelf. At the center bookcases the vertical illumination varies from 25 footcandles 5 feet above the floor to 15 footcandles at the bottom shelf.

Brightnesses at the time of illumination measurements were:

luminaire at 65° crosswise	500 fL	walls, side	50 fL
at 65° lengthwise	850 fL	rear	20 fL
ceiling	16 fL	floor	35 fL
bookcases	11 fL	table tops	55 fL

Lighting designed by Kelly & Morris, Consulting Engineers; U. C. Clarke, City Engineer; and LeRoy Cowan, City Architect, all of Jersey City, N. J. Lighting installed by R. W. Noel Electric Co., Inc., Jersey City, N. J.

Lighting data submitted by H. O. Spliethoff, Public Service Electric and Gas Co., 84 Sip Ave., Jersey City, N. J. as an illustration of good lighting practice and to aid in the design of similar installations.

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A.I.A. File No. 31*f*

APPLICATIONS

Aperture Fluorescent Lamps . . . Applied

S. C. Peek

A NEW fluorescent lamp has been developed for the primary purpose of providing a narrow, brighter source. A luminaire has also been designed to take advantage of these characteristics. This paper is an attempt to: (1) show why brightness and narrow width are important; (2) describe an integrated system; (3) show the results in various applications.

The introduction of aperture fluorescent lamps makes available linear light sources of smaller and brighter characteristics than were previously obtainable in fluorescent lamps. When these lamps are used with a half parabola reflector, the following characteristics can be simultaneously obtained: (1) high illumination at a remote point; (2) low power consumption; (3) sharp cut-off in the vertical distribution; (4) narrow vertical distribution; (5) small luminaire size; and (6) wide lateral distribution.

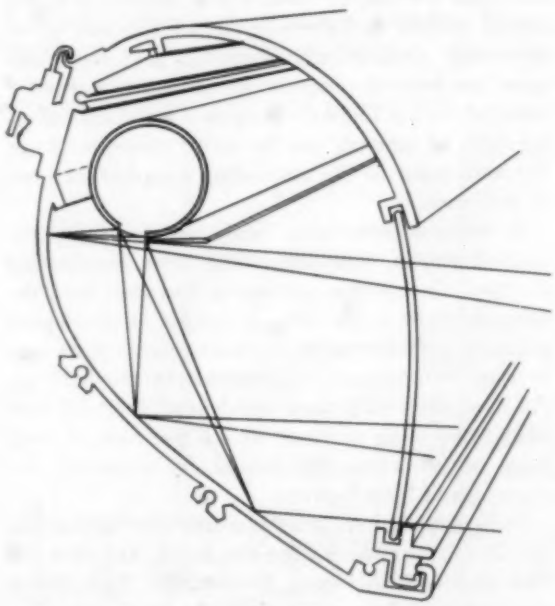


Figure 1. Cross-section of the aperture lamp luminaire with light shield.

The luminaire which can use, without modification, either a 30-degree or 60-degree aperture lamp is shown diagrammatically in Fig. 1.

Generally, the system is best-suited to lighting long, relatively narrow areas, such as roadways, building fronts, etc. These applications take advantage of the wide lateral distribution.

A section of the New Jersey Turnpike was illuminated by 40 aperture lamp luminaires with 30-degree lamps, mounted 38 inches high, spaced alternately, 10 feet and 30 feet apart. A section of an approach on Route 128 in Peabody, Mass. was lighted by 10 luminaires and an adjacent turn off lighted from the opposite side by an equal number.

Greater illumination at the center of runways is possible through the higher brightness of the aperture lamp system. Runways are much wider than roadways and, therefore, require larger reflectors in order to obtain equivalent uniformity.

The interior of a trailer truck was illuminated by the system with good results.

The wide horizontal distribution coupled with

AUTHOR: Sylvania Electric Products Inc., Salem, Mass.

A.I.A. File No. 31-f

sharp cut-off produced an interesting method of lighting marinas.

It is usually desirable, for architectural reasons, to mount luminaires for lighting building fronts close to the surface to be illuminated. Several building fronts were illuminated by the aperture lamp system with only 18-inch protrusions from the building.

Since only a narrow light source is needed to light plastic edge-lighted signs, the aperture lamp is well-suited to this application without any need for an auxiliary reflector or optical system.

The aperture lamp and associated luminaire were conceived as an integrated system to fill a need for greater throw and vertical control in fluorescent lighting.

(Abstract of IES Conference Paper No. 23.)

Engineering Designs for Residential Lighting

Norman Falk

The Illuminating Engineering Society has, over the years, established criteria used to determine luminaire design, express lighting performance, predict and evaluate in-service results, define visual comfort and establish seeing task requirements. This body of information has served to bring about far-reaching improvements in the lighting of industrial, street and highway, commercial and institutional areas.

The systematic application of these classic techniques of analysis of lighting systems and luminaire design to fulfill a set of predetermined performance requirements, specifically dictated by the needs of the home, can go far toward providing improved seeing conditions for the home—conditions in keeping with the quality to which we are accustomed in other daily seeing environments.

Principles of prismatic lens and refractor design have been applied in developing luminaires exclusively for home use, with results that can best be expressed in the standard language and shorthand of the illuminating engineer.

Such new engineering designs include an outdoor, prismatically-enclosed luminaire for ceiling mounting, or wall mounting, with dual-prismatic control to provide a sharp beam at 75 degrees from nadir, to cover a wide outdoor area, and a substantial downward component between 0 and 40 degrees to highlight the space directly underneath the luminaire, such as a doorway, a porch setting, a vehicle in a carport, an outdoor barbecue, etc.

Such a prismatic control luminaire will provide 136 per cent more output at 75 degrees, resulting in an extension of the spacing to mounting height ratio by a factor of 2, in comparison to conventional diffusing enclosures, generally in use.

For mounting heights ranging from 24 inches above the ground, for flower and shrubbery lighting, up to eight feet above grade, an especially wide-spreading, prismatically-controlled post top luminaire has been developed. Illumination, normally achieved with a 150-watt lamp in a standard diffusing type of lantern, can be easily surpassed by a 100-watt lamp in the controlled distribution type of pole unit.

A recessed luminaire, with precise, injection-molded acrylic, light-controlling trim, eliminating the need for all metal framing, has also been developed. Such a luminaire is capable of developing utilization efficiencies 93 per cent greater than, and average brightnesses approximately one-half of, the most commonly used residential drop-diffuser, while projecting as much as 4.6 per cent of total lamp output along the ceiling for improved environmental light balance.

It is hoped that these luminaire developments, specifically engineered for the home, are only the first step in bringing an increasingly high degree of comfort and see-ability into the home.

(Abstract of IES Conference Paper No. 47.)

Author: Holophane Co., Inc., New York, N. Y.

D. E. Husby

M. R. Anderson

Light Transmitting Plastic Enclosure For Outdoor Lighting Equipment

CONSIDERING a few of the application requirements of an enclosing media, factors such as vandalism, type of source, installation, and maintenance practices and luminaire brightness must be considered to determine the worthiness of clear plastics as an enclosing member. Many claims made by other industries for plastics are tainting the promotion and acceptance of plastics in lighting applications. For an area plagued with high vandalism rates on glass refractors or globes, it is a natural tendency to either consciously or subconsciously wish, and oft times ask for, plastic refractors, since plastic seemingly is unbreakable. Truly, however, plastics do break. True, some have higher resistance to breakage as compared to glass and some are nearly, for practical purposes, unbreakable; but are these materials applicable to the lighting field?

The purpose of the paper is not to delve into the chemistry of these plastics, but rather to furnish data obtained from testing which most simulates the physical treatment these outdoor luminaire "enclosures" will receive in shipment, installation, and prolonged service.

Testing consisted of inflicting blows to the specimens at specific vulnerable surfaces and angles.

Since a glass media is a past- and present-day enclosure with which users are very familiar, our tests used glass specimens as a control medium to relate the data obtained on the plastic specimens.

Fig. 1 shows the impact test stand which was adapted to this test procedure. It consists essentially of a ten-foot length of pipe through which a known weight may be dropped upon a test specimen at various known heights. The variable test positions used are indicated by a side view of this diagram; that of flat panel specimens, refractor shapes, which are impacted at 90 degrees to the refractor axis, and refractor shapes which are subjected to impact at a 45-degree angle. One factor not considered in the determination of impact strengths was that of internal friction between the weighted pellet and the inside of the pipe as it drops through the test distance. Since all tests were performed on the same basis, this factor is considered negligible, since we are endeavoring to show here relative values between glass and plastic.

These test panels shown in comparison in Fig. 2 would indicate generally that the plastic media surpasses glass as a resistant material to impact breakage. It appears that either acrylic material has a minimum impact value which is equal to the

AUTHORS: Westinghouse Electric Corp., Cleveland, Ohio.

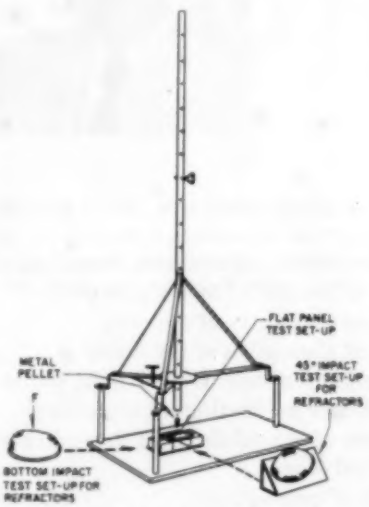


Figure 1. Impact test stand.

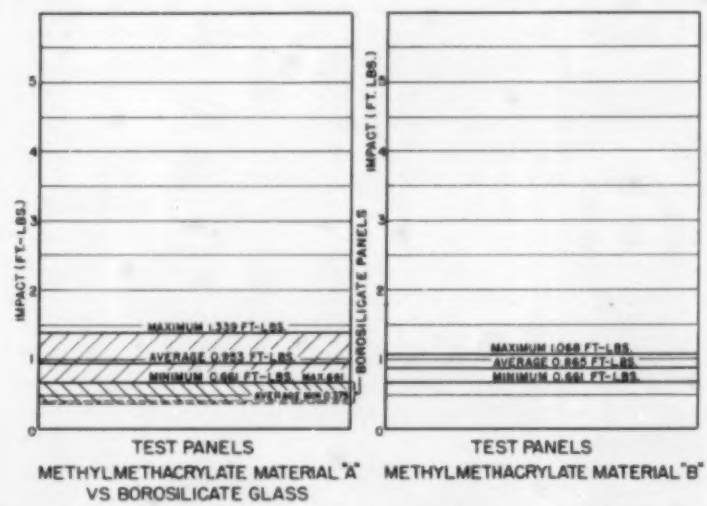


Figure 2. Comparison of resistance of glass and plastic media to impact.

maximum value found for borosilicate glass panels or, on an average basis, approximately 2.1 to 2.3 times as resistant to breakage as glass. The polycarbonate panels showed no damage at 5 ft.-lb. impact or in excess of 13 times the impact strength of borosilicate glass. These comparisons are real and valid for flat panels. These are also very common comparisons and can be expanded to cover nearly any application using a plastic material as compared to glass.

In comparing the strengths of acrylic and glass as molded, usable shapes, we used refractors which are duplicates, physically, and optically, for impact testing. In this set of values, the strength of acrylic does not compare so favorably as it had previously, in the flat panels. Noteworthy, however, is the fact that when the glass refractors broke, they shattered, whereas the acrylic refractors were not destroyed even when holes were punched through them. The usefulness of acrylic refractors does not end when they break.

Closely related to the impact strength of methylmethacrylate is the effect of temperature, according to popular belief. Common belief has it that at low temperatures, all plastics and, therefore, also methylmethacrylate, become very brittle and at elevated temperatures become more and more resistant to impact breakage.

It has been found that no detrimental characteristic is produced in acrylic by usage in low-temperature areas of outdoor lighting as a whole.

It must be concluded that, since acrylic enclosures or refractors are not truly unbreakable nor appreciably less susceptible to breakage as compared to glass refractors at this time, their worthiness must be based on their stability during thermal shock conditions and the fact that when breakage does occur, they do not shatter, but usually remain effectively whole and usable. This material then serves a great need today and, with its increasing acceptance, appears to be the beginning of a plastic era in outdoor lighting, particularly in view of the advancements made recently in the development of high-temperature, extremely high strength, and economical plastics, capable of being refined to clear, high-transmission materials.

(Abstract of IES Conference Paper No. 28.)

Darkroom Lighting Systems

Herbert S. Glick

THE PRACTICES and methods of darkroom lighting discussed in this paper are intended to apply primarily to larger operations wherein the major portions of entire single-story and muti-story buildings are dark-room areas. In these conditions all the light which can be tolerated by the product may be about 1/200,000 of a footcandle or less.

In the usual lighting installation, time is generally of little importance to the effect of the light. Time is very important in the photographic darkroom, however, because the effect of light on emulsions is cumulative.

The primary aim in darkroom lighting is to provide the greatest amount of useful visual light possible without damaging the product. This may be accomplished by placing the visual light where it will do the most good for the processor, but still keep it from falling on the exposed product as much as possible.

Some preliminary points involved for providing illumination in a given workroom for a specific purpose are:

1. Sensitivity (speed) of emulsion handled;
2. The spectral sensitivity of the product;
3. The spectral sensitivity of the eye;
4. The spectral absorption of the filters;
5. Spectral energy distribution of light source;
6. The time factor or duration of exposure;
7. The purpose of the safelight for determining:
   (a) Physical size;
   (b) Angle of propagation;
   (c) Intensity.

AUTHOR: Eastman Kodak Co., Rochester, N. Y.

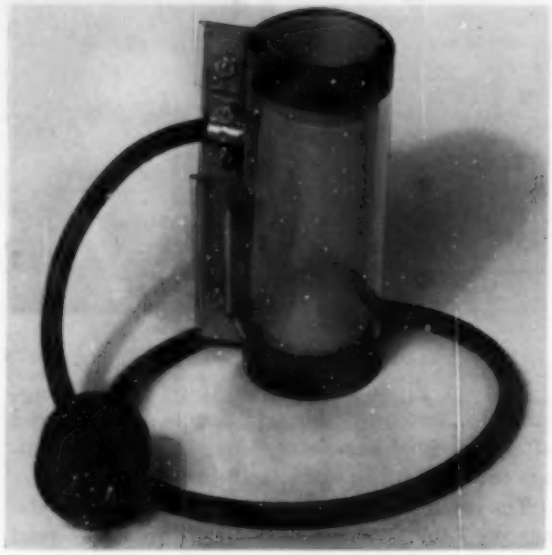


Figure 1. Cylindrical type electroluminescent safelight using flexible plastic encapsulated electroluminescent panels and designed to fit around pipe guard rails.

8. The general engineering and construction details of the safelights and their placement and distribution to provide optimum performance under the conditions demanded for product quality and job performance.

The efficiency of light production for white-light areas is the lumen output per watt of power input. The efficiency of a white-light luminaire is usually arrived at by taking all losses into consideration to arrive at the useful light which is available. For a safelight, however, the efficiency must take into consideration the effect of the safelight on the photographic material. Inasmuch as there is no practical "absolute efficiency" rating which can be applied to a safelight, the usual practice is to establish a "relative efficiency." This efficiency is established by comparing one safelight with another. In 1927, H. Arens and J. Eggert published a paper on darkroom lighting in which they define the "safety ratio" of two safelights as the ratio of the time required by the two safelights to produce the same photographic effect (fog), the brightness of the two lamps being identical.[1] Relative efficiency may also be defined as the relative safety time at equal levels of illumination.

A variety of safelights have been designed which may be used to provide general room illumination: floor lighting; workplace lighting; obstruction marker lighting; orientation and guide lighting.

As the factor which determines how much light can be used in a darkroom is the sensitivity of the product rather than the workers' visual needs, it is remarkable that high quality, efficient production can be carried on under lighting conditions which, in the usual sense, may be considered extremely sub-normal. Darkroom workers must depend much more on their other senses than those who work under normal lighting conditions.

We can, therefore, consider darkroom lighting not as a complete answer to the workers' visual needs but rather as a tool to assist him in his work.

1. Arens, H. and Eggert, J.: "Darkroom Illumination with Special Attention to the Psychological Sensitivity of the Human Eye," *Zeitschrift fur Wissenschaftliche Photographie*, Vol. 24, No. 7, pp. 229-248 (1926).

(Abstract of IES Conference Paper No. 6.)

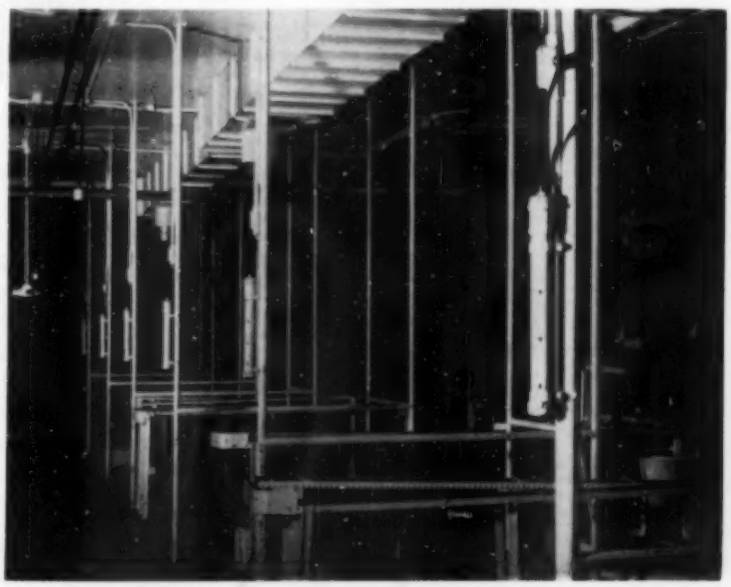


Figure 2. Production darkroom showing application of obstruction markers (pipe lights), beehive type safelights with ports, recessed wall guide light.

Maintenance Factors for Interior Lighting

R. N. Edwards, Jr.

THE CURRENT method of calculating the minimum maintained-in-service illumination level is one whereby a single typical maintenance factor (MF) combines lamp lumen depreciation with dirt depreciation of luminaires, lamps, and room surfaces. This MF should represent the maximum loss of light, but does it? It is proposed that the typical good, medium, and poor MF be broken down into its component parts. The first component part is lamp lumen maintenance. That lamps depreciate at different rates is well known; yet, the typical MF's published for a given line of luminaires may be the same regardless of the lamp used. The minimum lumen maintenance factor for group replacement is the value at replacement time, taken from a given lamp lumen depreciation curve. The minimum lumen maintenance factor for random replacement is not the average lumen output through rated lamp life. It is obvious from lamp mortality curves that the average lumen output through rated life completely ignores 50 per cent of the lamps that burn longer than rated average life. A more accurate approach is the graphical integration of the lamp lumen maintenance curve over the installation life.

AUTHOR: Westinghouse Electric Corp., Cleveland, Ohio.

Loss in illumination from burned-out lamps must be accounted for. If lamps are replaced after 5 per 100 have burned out, then a lamp outage factor of 0.95 should be included.

The second component part is luminaire maintenance. Table I shows data for three commercial luminaires in air-conditioned officers. A study of previous papers on MF's indicates that luminaire dirt depreciation follows an exponential function which approaches an asymptote, other than zero, different for each luminaire. Fig. 1 shows an average curve. From Table I, one assigns 33 months to time Y, and to point X, for example, 0.88 for Unit B. Luminaire maintenance factors for shorter periods of time can then be determined. All previous maintenance work can and should be used.

The last component of maintenance is room sur-

TABLE I — Test Results: Commercial Fluorescent Luminaires in Air-Conditioned Offices. Unit A in one office; units B and C both in second office. Length of test—33 months with random replacement. Operating hours per day—12.

UNIT		A			B		C	
Over-all dimensions—length x width x height (inches)		48 $^{9}/_{16}$ x 15¾ x 4¾			48 x 11¾ x 4¾		24 x 11¾ x 4¾	
Finish		Baked white enamel			Baked white enamel		Baked white enamel	
Shielding		35° x 25° metal louver; illuminated metal side panels			Crystal, light-stabilized polystyrene control lens panel		White translucent, light-stabilized, polystyrene 45° x 45° louver. (Cell size is a $^{11}/_{16}$" cube.)	
Distribution		Direct-indirect			Direct		Direct	
Number and type of lamps		Four F40W			Three F40W		Three F20T12/W	
Mounting		Suspension—21" hanger			Recessed — inverted T (grid) acoustical ceiling			
Coefficients of Utilization × .01 for 80% Ceiling; 50% Walls; 30% Floor								
Room Ratio	(Index)	Dirty	Clean	New*	Dirty	Clean	Dirty	Clean
0.6	(J)	22	23	31	27	31	22	27
0.8	(I)	30	31	40	35	40	28	34
1.0	(H)	36	38	46	40	46	32	39
1.25	(G)	42	44	52	45	52	36	44
1.5	(F)	47	49	57	49	56	39	48
2.0	(E)	53	56	62	54	61	43	53
2.5	(D)	59	62	66	58	65	45	56
3.0	(C)	62	65	69	60	68	48	58
4.0	(B)	67	71	73	63	72	50	61
5.0	(A)	72	76	75	65	74	53	64
Efficiency (per cent)		77.1	80.8	65.9	57.6	65.0	45.2	56.4
Finish, average reflectance		85%	86%	**	***	87%	***	86%
Actual dirt depreciation		5%			12%		18%	

*Only unit with published photometric test report.
**Published specification for units A, B, and C new, is 85 per cent minimum.
***Dirt accumulation was not uniform; therefore, average reflectance value was not determined.

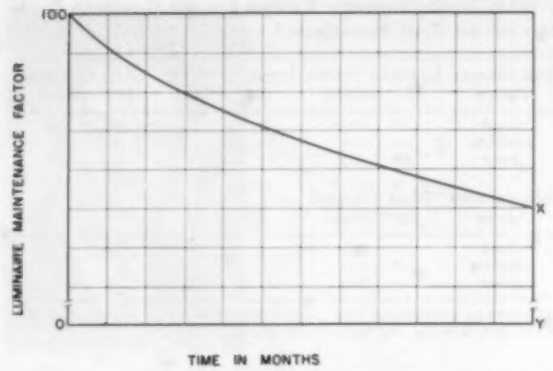


Figure 1. Assumed luminaire depreciation curve for Table 1, commercial and clean industrial areas. Curve shape is taken from previous maintenance paper.[1]

face depreciation. Since this is not a function of lamp or luminaire depreciation, it should be considered separately. A logical approach to minimum maintained footcandles is to choose coefficients of utilization based on anticipated minimum-in-service room surface reflectances.

Component maintenance factors will do much to relieve the uncertainty of typical maintenance factors while providing a means for obtaining more realistic minimum maintained-in-service illumination levels.

1. Oetting, R. L. and Tuttle, J. W.: "Tests Aimed at Realistic Maintenance Factors," ILLUMINATING ENGINEERING, Vol. XLVIII, No. 5, p. 242 (May 1953).

(Abstract of IES Conference Paper No. 46.)

Performance of Air-Handling Troffers

B. S. Benson, Jr.

E. H. Witte

To OBSERVE the behavior pattern of air-handling troffers and to obtain additional application engineering data, a comprehensive survey of combination light and air troffers was conducted in installations scattered throughout the eastern half of the nation. At each location, users were interviewed to obtain their evaluation of the system and physical tests were conducted to obtain data on air handling and photometric performance.

Both the subjective observations of the users and the objective tests conducted by the authors indicated that air movement conditions were conforming to desired design levels. Sound generation, often a problem with air diffusers, was not noticeable in any case, even though many installations were visited after normal working hours when ambient noise levels were much reduced.

To determine applicable maintenance factors, representative troffers at each installation were measured for total light output before and after a thorough cleaning. From this data, and recognized practices concerning frequency of cleaning and lamp replacement, maintenance factors were developed. These factors, when compared to the maintenance factors listed in the current *IES*

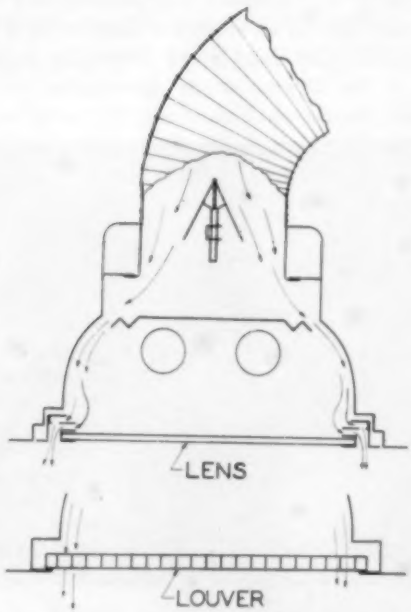


Figure 1. Cross-section of air-handling troffer with lens or louver enclosure.

AUTHORS: Thomas Industries, Inc., Benjamin Division, Des Plaines, Ill.

Lighting Handbook for comparable non-air-handling troffers, indicate that the Handbook figures may be applied to air-handling troffers with little or no sacrifice in accuracy.

Dirt collection patterns, both inside and outside of the luminaires, were observed and photographed. In most cases, the difference in dirt patterns between air-handling and non-air-handling troffers was remarkably slight.

From the results of the investigation it is apparent that the air-handling troffer is a well-accepted tool for the illuminating engineer. The use of this type of lighting equipment as a source of low-velocity air inlets results in both good air and good lighting solutions.

TABLE I—Maintenance Factors for Air-Handling Troffers of the Type Investigated.

Maintenance Factor	Louvered Troffer (12" Wide)	Louvered Troffer (24" Wide	Glass Covered (12" Wide)
Good	.77 (.75)*	—	.73 (.70)
Medium	— (.70)	.68	.63 (.65)
Poor	.66 (.65)	—	.54 (.55)

Maintenance Factor	Glass Covered (24" Wide)
Good	.77 (.70)
Medium	.67 (.65)
Poor	— (.55)

*Figures in parentheses are those listed in the *IES Lighting Handbook*, 3rd Edition, for comparable static troffers.

(Abstract of IES Conference Paper No. 44.)

Static Converters for High-Frequency Fluorescent Lighting

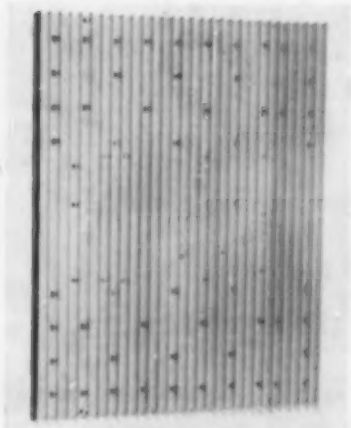
W. H. Johnson

THE FIRST practical transistorized high-frequency converter was a 1½-kw unit utilizing an "ell" type circuit with transistors operating in series. The latest converter design is rated at 3 kw and uses a bridge-type circuit that does away with complex, time-consuming matching of transistors.

Installations using the 3-kw converter are in operation at the Cleveland Engineering and Scientific Center and in an electrical distributor's warehouse in the Cleveland area. Presently being installed is the largest single installation of high-frequency fluorescent lighting in the world to date. Hamilton City Hall in Hamilton, Ontario, Canada will have approximately 450 kw of high-frequency lighting. Over 9000 standard 40-watt, rapid-start lamps, operating at 1500 cycles per second, will provide the general illumination throughout this building.

(Abstract of IES Conference Paper No. 7.)

AUTHOR: Westinghouse Electric Corp., Cleveland, Ohio.



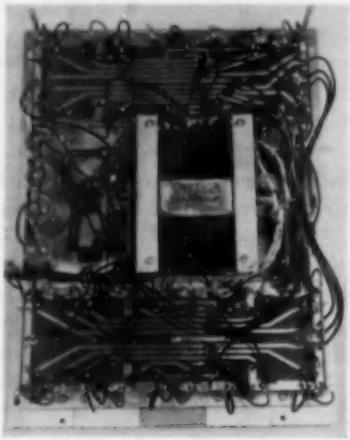


Figure 1. Left: Front of 3-kw converter showing aluminum heat radiating fins. Physical dimensions are approximately 18 inches by 24 inches by 6 inches. Right: Back of 3-kw converter showing that portion of converter which recesses into cabinet. Extensive use is made of printed circuits. Black box in center is output transformer.

E. B. Karns

Lighting of Airport Service Areas

Service Area Seeing Tasks

Primary functions of the service area lighting installation are (a) to enable the pilot to guide (taxi) his aircraft into final positioning for loading and service; and (b) to provide lighting suitable for personnel to load and unload passengers and cargo, load fuel, and perform other apron service functions.

In order to provide optimum visibility for the approaching pilot, it is essential that the service area pavement be lighted uniformly within a 4 to 1 uniformity range (average to minimum). This may be done if suitable attention is paid to the type of light sources, their optical systems, and location of equipment with relation to the service area. Above all, attention must be paid to the reduction of disability and discomfort glare.

Servicing of Aircraft

Practically every other visual task performed upon the service area employs light reflected from the working surface. This requires direct illumination of relatively high levels. Surfaces range from horizontal to vertical. Average illumination levels of at least two footcandles maintained in service are normally considered necessary for illumination of objects where fine visual acuity is not essential.

Acceptable Methods of Lighting Design

The most important consideration in designing the lighting installation, aside from the essential nature of providing uniformity of illumination of the service area pavement, is that of keeping glare to a minimum. Glare from bright sources in line of sight are particularly troublesome to control-tower operators and pilots of the aircraft taxiing in the general vicinity, as well as to service personnel, passengers, and, in short, everyone making use of the service area and service area facilities.

Good service area lighting for single-row aircraft parking without the use of floodlights at higher mounting heights is possible, as illustrated by New Orleans' Moisant Airport (Fig. 1). The lighting was designed by Mr. L. N. Goodman, Consulting Engineer. It consists of 1000-watt mercury lamps in roadway lighting luminaires with shields; mounting height is 35 feet and spacing is 60 feet. It provides an average of 2 footcandles over a 100-foot band, with approximately 0.3 footcandle horizontal and 0.5 footcandle vertical at 100 feet out from the building.

Conclusions

Service area lighting, generally speaking, has not received the attention it warrants. Too often the designer, as well as the operator, has not fully realized the importance of this area.

The IES "Recommended Practice for Airport Service Area Lighting," as now published, provides minimum values maintained in service, and should be considered as such. The cost of service area lighting in excess of these values is a small percentage of the total cost of a modern airport.

Higher levels of illumination are justifiable. They improve the safety and efficiency of the operation and add prestige to airlines using the facilities. Furthermore, it is important to the airport management to install higher levels of illumination to impress the public with its progressiveness and consideration for the safety and comfort of those who use the airport's facilities.

(Abstract of IES Conference Paper No. 8.)

Figure 1. Moisant Airport, New Orleans — 1000-watt mercury luminaires with shields at a mounting height of 35 feet on 60-foot spacing; average footcandles, 2.0.

AUTHOR: Westinghouse Electric Corp., Cleveland, Ohio.

Design and Performance of an Inset Runway Light

C. H. Loch

THE PLACEMENT of signal lights in the runway pavement to provide the new narrow gage, centerline, and taxiway exit lighting configurations imposes new requirements on the design of airport lights.

The optical requirement of an exposed luminous area, which provides the most useful low-angle light, works directly against the safety requirement of a completely flush light, which removes all hazard to aircraft.

The most important mechanical consideration is that these lights lend themselves to relatively simple and inexpensive installation in existing runways as well as in new runways. Another mechanical requirement is that they withstand any load or impact that they may be subject to, such as impacts of landing aircraft, snowplow blades, tailhooks, truck tire chains, etc.

The light must operate under all the weather extremes, whether completely submerged under water or ice or subjected to the high velocities of hot winds from jet exhausts.

The availability of the compact, high-lumen maintenance, quartz iodine-cycle lamps made possible the design of a small inset light, shown in Fig. 1, which meets the requirements outlined above. It is to be installed in an eight-inch-diameter, one-inch-deep recess in the pavement. A $\frac{3}{8}$-inch-wide, one-inch-deep slot connects the recess and serves as a wireway to connect the light with its transformer, which is located off the edge of the runway. Modern diamond drills and saws are used to make the recesses for the lights and cut the slots for the wires. When the inset light is installed, it presents a gradually sloped profile which protrudes only $\frac{1}{8}$ inch above the runway surface.

Of the possible optical systems, a lens was chosen because it could give higher beam candlepower and better performance at low angles. It could also be sealed in the luminaire to keep dirt and debris from accumulating around the lamp.

Typical photometric performance is shown in Fig. 2. The curve is a vertical candlepower trace through the lateral beam axis. The beam is rectangularly shaped, approximately 26 degrees wide, with rounded corners.

These lights are currently being installed in several United States Air Force runways for field evaluation.

(Abstract of IES Conference Paper No. 9.)

AUTHOR: Westinghouse Electric Corp., Cleveland, Ohio.

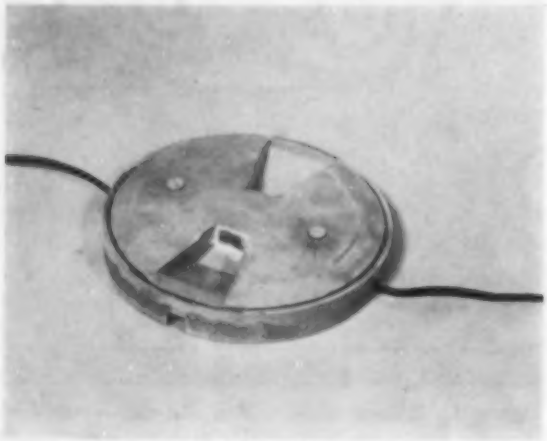


Figure 1. A bidirectional 45-watt inset light.

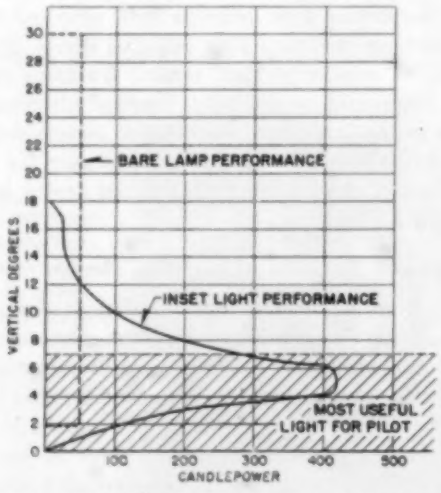


Figure 2. Typical performance of a bidirectional 45-watt inset light.

LIGHT SOURCES AND BALLASTS

Developments in Quartz Infrared Lamps

William F. Hodge

Use of the quartz infrared lamp has expanded very rapidly since its introduction in 1954. Many more varieties have been developed, covering present applications quite thoroughly. Translucent quartz types cover general purpose baking, drying, and food-preparation applications. Special clear quartz lamps with small diameter extra-straight filaments serve as line sources for use in office copying machines. Clear quartz lamps, operated far above normal loadings, are used to test materials, structural parts, models, or whole structures related to aircraft, missiles, and space vehicles. For particular operating conditions several special varieties are available.

Lamps for Universal Burning Position

In vertical operation, filaments over five inches long, approximately, are heavy enough so that they sag, due to their own weight, while burning. A lamp for vertical operation has been developed which has small indentations in the quartz tubing, spaced at suitable intervals. The tantalum discs used to support and center the filament rest on these indentations, dividing the filament weight into small enough parts so that it will not distort in operation.

High-Wattage Lamps for Missile and Space Vehicle Testing

In testing materials and parts for missiles and space vehicles it is necessary to simulate, in the laboratory, the conditions that will actually be encountered. An example is atmospheric re-entry, with consequent air friction heating effects. Huge banks of very closely spaced, clear quartz infrared lamps are ideal for heating specimens, because the small thermal capacity of the lamps allows rapid, precise control of temperature and its distribution. Lamp wattage is often three, or more, times normal to obtain rapid temperature rise. Fig. 1 shows three lamps designed for such purposes. The upper lamp is a 100-watt-per-inch type; the middle one, 200 watts per inch. The lower lamp is designed for 360 watts per inch at "normal" voltage. For intervals of a few seconds, it can be operated at as high as 1500 watts per inch.

Platinum Leads for Very High Temperature Operation

The molybdenum ribbon leads used at the ends

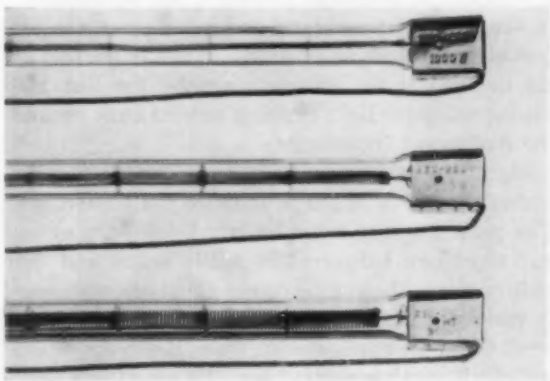


Figure 1. The developmental 360-watt-per-inch filament in the bottom lamp dwarfs the 100- and 200-watt-per-inch filaments in the two lamps above. Although the 360-watt-per-inch lamp has a short life when overvoltaged, it will operate satisfactorily for many hours at the nominal 360 watts per inch.

AUTHOR: General Electric Co., Cleveland, Ohio.

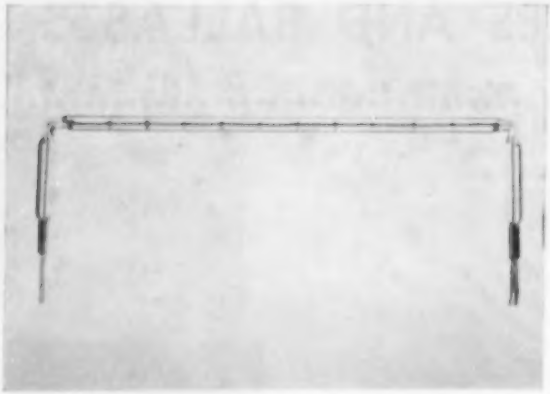


Figure 2. Long dead ends bent at right angles to the axis of the lamp proper allow location of the seals behind the reflector to keep them cool.

of quartz infrared lamps will operate satisfactorily for thousands of hours at temperatures below 650°F. At higher temperatures they oxidize and disintegrate. In missile and space vehicle testing, energy concentration may raise the seal temperature to as high as 1500°F; and lamp life will be impractically short. In this case, substitution of platinum wire for the outer portion of the inlead is often helpful, and results in useful lamp life even where seal temperature is as high as 1500°F. Unfortunately, use of platinum leads does not result in longer life at lower temperatures that exceed 650°F.

The Bent End Lamp—A Logical Solution to the Seal Oxidation Problem

If the lamp seals can be sufficiently isolated from the region where the energy is utilized, they will not overheat and oxidize. A recent development, shown in Fig. 2, is a lamp with the end dead space extended to about two and a half inches, and the tubing bent at right angles. This allowr the long dead end to project through a hole in the reflector surface, removing it entirely from the hot region.

(Abstract of IES Conference Paper No. 18.)

Fluorescent Lamps for Photo-Duplicating Service

Carl J. Bernier

THE COPYING machine is becoming as much of an office fixture as the typewriter. Sales of all types of copying equipment have quadrupled in the last ten years, and today's figures are expected to be doubled by 1965. A major portion of the demand is for compact, simple, low-cost machines, using the light copying process built around the fluorescent light source.

Light sensitive papers have spectral response curves similar in shape to those of the human eye. The peak response wave length, however, may occur anywhere between 360 millimicrons and 700 millimicrons, depending upon the type of paper. A variety of fluorescent phosphors have been developed for these applications; thus, the designer can match the peak emission wave length of the lamp to the peak response wave length of any paper. The lamps have high efficiency, generate little heat, and come up to maximum light output at once.

The paper discusses several of the major types of processes used in light copying equipment and outlines features of fluorescent lamps designed for each process. Items of particular interest are the recently developed high-reflectance material used in ultraviolet emitting reflector lamps, for light absorption processes, and the new high-brightness "aperture lamp," developed for machines employing image-scanning or image-projection principles.

(Abstract of IES Conference Paper No. 1.)

AUTHOR: Sylvania Electric Products Inc., Danvers, Mass.

Design and Characteristics of Aperture Fluorescent Lamps

C. L. Toomey

CONTROL of lumen output from a fluorescent lamp is usually a function of luminaire design, within the limitations of the light source itself. Good control can be more easily realized if the light source is as small as possible and as bright as possible. The ordinary fluorescent lamp is inherently a low-brightness, large-area source. However, a recent innovation, called the aperture fluorescent lamp, approaches the requirements for a small-area, high-brightness source. In this lamp, advantage is taken of the high internal phosphor brightness by revealing it through a narrow aperture cut into the phosphor coating along the entire length of the lamp. Aperture brightness is increased by a factor of approximately two, by placing a reflector coating between the phosphor and the glass. A cross section is shown in Fig. 1.

Special glass is necessary to prevent poor lumen maintenance since the highly active mercury arc is in direct contact with the glass in the aperture.

The design of this lamp is based on the circular cross-section, 1.5-ampere, extra-high-output fluorescent lamp. Electrical characteristics are the same as the extra-high-output lamp and lamps may be operated on commercially available ballasts.

Fig. 2 shows a comparison of the candle-power distribution of the 30-degree aperture lamp, the 135-degree reflector lamp and the regular extra-high-output lamp.

The sharp cut-off and high aperture brightness obtainable with the 30-degree aperture lamp is shown in Fig. 3; lamps having 60-degree and 90-degree aperture are shown for comparison.

The aperture fluorescent lamp can be used in applications where narrow beam width and high beam candle power are necessary in order to produce a controlled distribution of light.

Highway lighting, edge lighting of signs, lighting of ceilings and walls all require the precise optical control obtained with the aperture fluorescent lamp. The aperture idea is also being incorporated into lamps used for photo-duplicating service.

(Abstract of IES Conference Paper No. 21.)

AUTHOR: Sylvania Lighting Products Inc., Danvers, Mass.

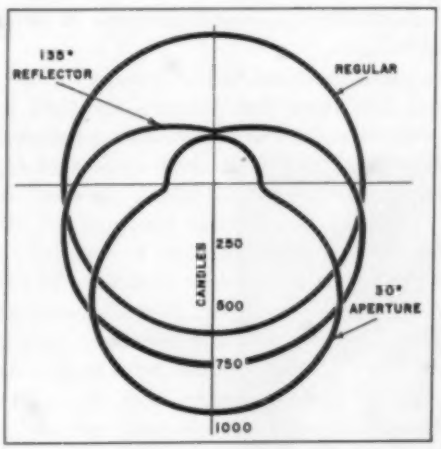


Figure 2.

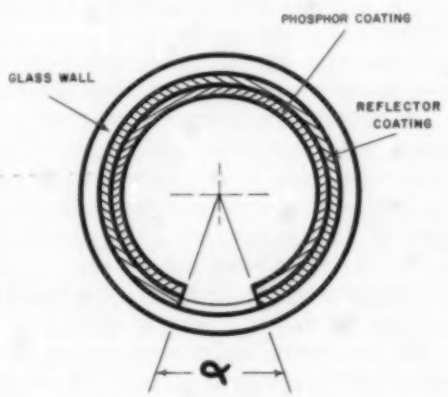


Figure 1.

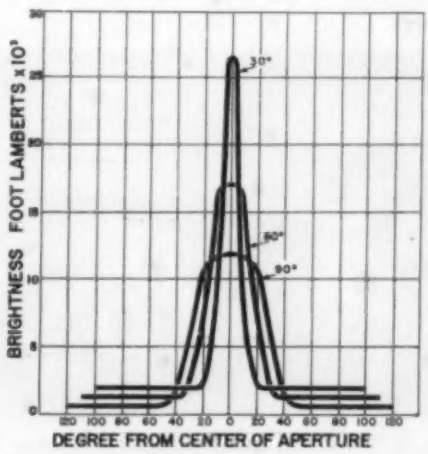


Figure 3.

R. W. Haggstrom

Mercury Ballast as an Integral Part of The Street Lighting Luminaire

THE LATEST street lighting development, incorporating the ballast within the luminaire, has come about through recent advances in lamp and ballast designs.

The paper describes ballast designs for use in an integral luminaire that contains the light source, light control and all of the ballasting equipment in one enclosure. Fig. 1 illustrates one such type of integral luminaire. The ballast location in the same enclosure as the lamp produces an environmental thermal situation that is not encountered when the ballast is remotely mounted. To neutralize the thermal condition, special precautions are necessary in positioning and mounting components, such as: (1) intimate contact with shell; (2) heat shields; (3) location remote from lamp; (4) heat conductors between components and shell; (5) location not above lamp.

AUTHOR: Jefferson Electric Co., Bellwood, Ill.

Figure 1. Typical integral luminaire containing ballast components.

TABLE I — Minimum Starting Temperatures for Mercury Lamps with Reactor Type Ballasting.

Lamp Type	Rated Line Voltage 240 Volts	277 Volts	480 Volts
100 Watt H4	+ 12 F	— 20 F	
175 Watt H22	— 10	— 20	
250 Watt H5	Zero	— 20	
400 Watt H1	+ 20	— 10	
400 Watt H33	— 20	— 20	
425 Watt H17			— 20 F
700 Watt H18			— 20
700 Watt H35			— 20
1000 Watt H15			— 20
1000 Watt H36			— 20

Ballast insulating systems are discussed, indicating how small size and weight are achieved through the use of Class F materials. Special considerations in locating and mounting capacitors are indicated, because of their limitations concerning temperature.

The reactor is the simplest, least expensive form of ballasting. The use of reactors, however, is linked directly to the power distribution system, since this circuit voltage must be equal to or greater than the required open-circuit voltage necessary for lamp starting and temperature involved. Tables for minimum starting temperature and line current characteristics are tabulated. In Table I, note that lamps rated 100 through 400 watts are suitable for use on 240- and 277-volt circuits and the 425-, 700- and 1000-watt lamps are suitable for use on 480-volt circuits.

Constant-wattage ballasts have many noteworthy features in addition to controlling lamp watts to within two per cent despite line voltage fluctuations of 13 per cent. The circuitry and construction of constant-wattage ballasts provides several other important advantages, such as: (1) no line inrush; (2) no need for primary taps; (3) low starting current; (4) low extinguishing voltage; (5) low line current during abnormal conditions; (6) insensitivity to harmonics; (7) isolated circuitry; (8) always high power factor.

High operating lamp current crest factors can increase lumen maintenance and increase cost of light. A ballast-lamp operation at greater than 1.85 crest factor represents greater cost of light. Fig. 2 shows a graph of crest factor *vs* line voltage for typical constant-wattage and reactor ballasts. The cost of light is inversely proportional to the mean lumens; since mean lumens are not appreciably affected when the crest factor is below 1.85, there is no difference in cost of light for either type. Ballasts having higher crest factors could be less costly but the resultant reduction in cost would not offset the rise in total cost of light, since the

ballast cost is only a small part of the total lighting installation.

Design engineers will have a full and complete ready reference of data concerning ballasts for integral luminaires from the paper. It also provides the lighting engineer with the knowledge needed to properly select the right ballast for his application. The choice of a reactor is determined either by voltage on an existing circuit or by planning and designing into a new system the regulation and line-voltage variation compatible with reactors. In new installations, the line regulating feature and other advantages of the constant-wattage ballast must not be overlooked. The regulating feature of constant-wattage ballasts permits the use of minimum wire sizes, maximum distance between lamps and maximum number of lamps.

(Abstract of IES Conference Paper No. 29.)

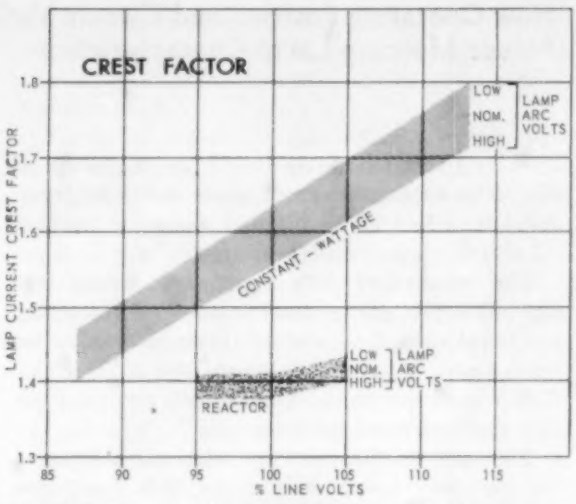


Figure 2. Comparison of crest factors for typical reactors and constant-wattage ballasts operating lamps horizontally.

Derivation of Ballast-Lumen Ratio

J. C. Heffernan

THE MEASUREMENT of ballast per cent light output for extra-high-output lamps has created serious problems for the testing laboratories because of the extreme sensitivity of the lamp to air currents and temperature. The protracted stabilization period to reach proper operating conditions has also aggravated this condition.

In order to measure these lamps, the testing laboratories have devised short-cut methods to speed stabilization and to maintain lamps at a certain condition for protracted periods. This is done by various water cooling setups with the lamp mercury temperature and pressure held at a constant value by immersion or contact with water at a specific temperature. There are advantages and disadvantages to this system but the high cost of the manufacture and maintenance of this equipment makes its value questionable to those laboratories that may make only a few measurements a year of this type.

It is the purpose of this paper to show how two main relationships can be used to compute the per cent light output:

(1) luminous efficacy is a function of electron density or lamp current;
(2) the amount of light generated by a given lamp is proportional to the power input to the lamp, lamp current remaining constant.

The basic formula for this is:

$$\text{Ballast Per Cent Light Output} = \frac{\text{Lamp Wattage} \times \text{Efficacy Factor}}{\text{Rated Wattage}}$$

where efficacy factor is a variable depending on the lamp current.

(Abstract of IES Conference Paper No. 37.)

AUTHOR: Sylvania Electric Products Inc., Danvers, Mass.

How Operating Position and Circuit Variations Affect Mercury Lamp Characteristics

W. M. Waldbauer

J. A. Walick

M. C. Unglert

H. D. Frazer

Tests were conducted on a group of H33-ICD 400-watt mercury vapor lamps to determine the effect of circuit and operating position variations upon lamp characteristics.

The average of data from eight lamps was utilized to plot curves showing the effect of varying the impedance of a standard linear reactor ballast upon lamp wattage and lumen output (Fig. 1). This was done with the lamp in both vertical (base up) and horizontal positions.

These curves illustrate the relationship between wattage and lumen output for this particular circuit and this group of lamps. For example, to provide 100 per cent of rated wattage to a horizontally-mounted lamp (wattage compensation), it is shown that the same circuit must deliver to the same lamp 101.5 per cent of rated wattage in a vertical (base up) position. The resultant light output will then be 96 per cent and 103 per cent of rated lumens for horizontally- and vertically-mounted lamps, respectively. Similarly, to provide 100 per cent of rated lumens from a horizontally-mounted lamp (lumen compensation) would require 102.5 per cent of rated wattage to the horizontal lamp. The same circuit would deliver 104 per cent of rated wattage to a vertical lamp.

Fig. 2 illustrates the effect which variation of circuit-type and line voltage has upon the wattage and lumen output of a horizontal lamp. These curves represent the average of eight lamps. The reactor-type circuit is much more sensitive to line-voltage variations than is the regulated output circuit, as is shown.

In addition to the above, the paper illustrates the effect of arc voltage variations on the output of the reactor, auto-transformer, and regulated output circuits. The pros and cons of lumen and wattage compensation are discussed. Recommendations for additional lamp standards are suggested.

(Abstract of IES Conference Paper No. 26.)

Authors: Messrs. Waldbauer and Walick, Westinghouse Electric Corp., Cleveland, Ohio; Messrs. Unglert and Frazer, Westinghouse Electric Corp., Bloomfield, N. J.

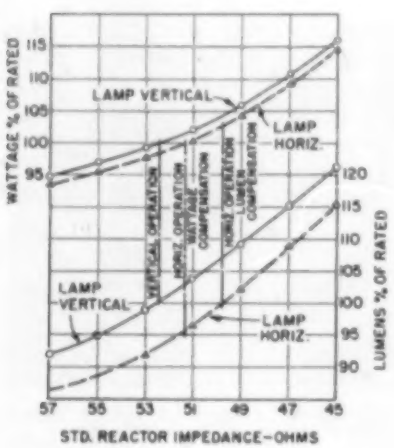


Figure 1 (left).

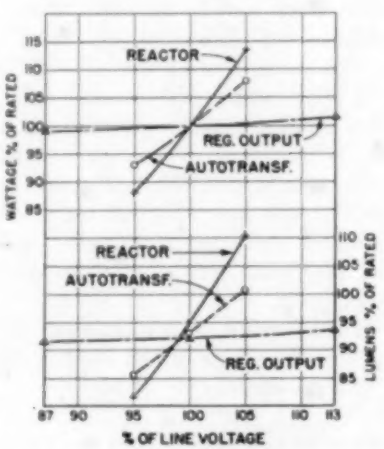


Figure 2 (right).

Donald D. Hinman

Robert S. Fox

40-Watt Fluorescent Lamp With Higher Light Output

Several new design features have been successfully incorporated into the 40-watt T12 fluorescent lamp, with a resultant substantial increase in light output and in lumens per watt. Of the 40-watts input to a lamp of this size, about one-third is dissipated in the filling gas and at the electrodes. Since none of this contributes directly toward the production of light, these losses offer opportunities for substantial improvements.

The decrease in lamp watts with reduced filling gas pressure is shown in Fig. 1. Shorter lamp life and a higher rate of lumen depreciation at lower pressures impose practical restrictions upon the choice of pressure. However, improvements in cathodes and phosphors can result in a lower pressure for the best over-all lamp design.

When the lamp electrodes are functioning as anodes, the power consumed depends upon surface area. The decrease in lamp watts for anodes of various sizes is shown in Fig. 2. Thus, there are two ways by which the lamp input watts can be reduced without any loss of lumens: lower pressure and larger anodes.

Although lamp lumens per watt can be raised by such means, it would be better still if the input watts were increased to the original value, with a corresponding increase in lumens. The addition of neon to the argon filling gas increases lamp input watts and light output. Lamps with various additions of neon to the filling gas were measured to determine their characteristics. At constant current, the increase in lamp lumens is proportional to the per cent neon in the filling gas. Lumens per watt are nearly constant in the range of zero to fifty per cent neon.

The lower density of neon-argon mixtures generally results in shorter life and faster lumen depreciation. The use of better phosphors and a new cathode design minimizes these difficulties and provides satisfactory lamp performance.

A practical combination of these several parameters—lower filling pressure, larger anodes and addition of a small percentage of neon—results in increases of five per cent or more in lumens and lumens per watt. These increases are independent of, and add to, any gains achieved by improved phosphors.

(Abstract of IES Conference Paper No. 24.)

Authors: General Electric Co., Cleveland, Ohio.

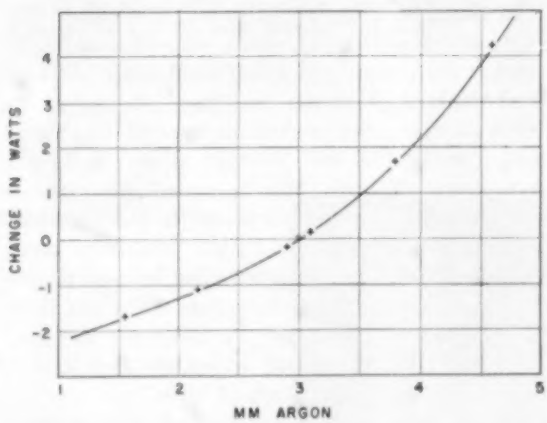


Figure 1. Effect of filling gas pressure on watts of a 48T12 lamp at 0.43 amperes.

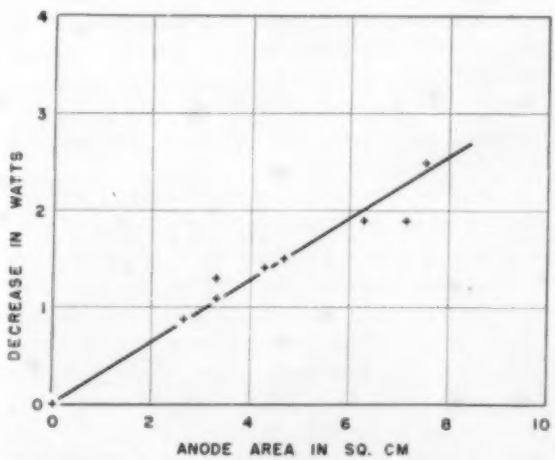


Figure 2. Effect of total anode surface area on watts of a 48T12 lamp at 0.43 amperes.

A New Two-Level Lamp for Residential Application

George J. Edwards

Mary E. Webber

A NEW incandescent lamp with two levels of light has been designed for use in three-way sockets to provide more efficient high-level operation and more trouble-free life than is characteristic of the presently-available three-level lamps.

A major cause of dissatisfaction with the conventional three-level lamps is conflict between the natural desire of the user to get the longest possible service from the lamp and the unsatisfactory light levels after one filament has burned out. This is especially troublesome because the dead filament is usually the one most often used.

In the new lamp, an extra-long-life minor filament operates only in series with the major, so there is little chance of a half-dead lamp. At high level the lamp is 20 per cent more efficient in the 100-watt size than is the equivalent three-level lamp; in the 150- and 300-watt sizes it is 14 per cent more efficient. The increased efficiency is made possible by concentrating all the high-level wattage in one filament. In the three-level lamp, two smaller wattage filaments must be used to produce the high level. For average lamp use there is an economic advantage in using the two-level lamp for all cases except where the low level is used for extra-long periods of time.

Fig. 1 shows the change in base wiring which makes a two-filament lamp operate in the new "high-low-high-off" switching sequence in any conventional three-way socket.

While a ratio of approximately 4 to 1 between high- and low-level lumens was chosen as giving desirable lighting levels with all wattages, almost any ratio can be selected by changing the resistance of the minor filament, while keeping its design life constant. Of course, the low-level wattage and efficiency would be different.

It may be expected that the consumer will receive, with no additional bulb or electricity cost, an actual increase in illumination of the same order as the lumen increases provided by the new lamp bulb construction. This applies for each wattage size of the soft-white, two-level lamp over the three-level type. The increased output of the new 150-watt lamp, used in a CLM type diffusing bowl, even makes it possible to obtain practically the same illumination on the reading test plane as from 150 watts in a three-level lamp, without any diffusing bowl. In addition, the selection of the high level necessary for visual activities is simpler with the two-level lamp, since the light output difference between levels is more apparent than with the three-level lamps.

If most consumers are to realize the full benefit of the extra light output, better design is required than is available in the portable lamps that are mass-supplied today. The majority of presently-available portable lamps do not have diffusing media capable of efficiently directing the light upon most home visual tasks.

The low level of the newer lamps appears to be materially lower than that of the three-level types, due to its distinctively yellowish light quality, even

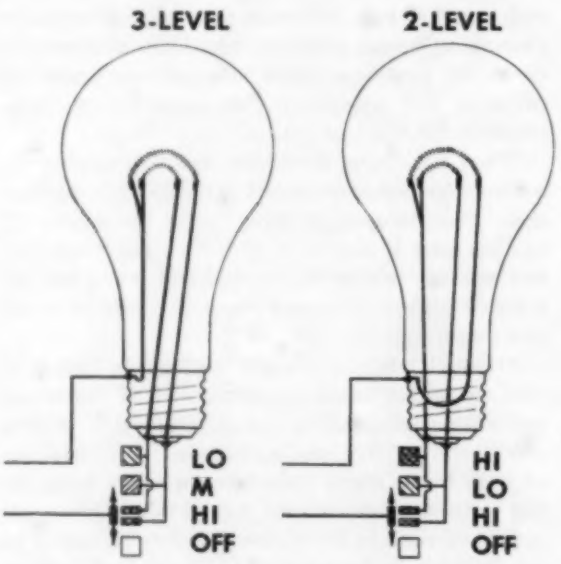


Figure 1. Base connections and switching of three-level and new two-level lamps.

AUTHORS: General Electric Co., Cleveland, Ohio.

though the lumen output is practically the same or somewhat higher, varying with lamp wattage. This can be a real asset both in avoidance of the use of the low level for eye tasks and for its association with the relaxing light quality of the open fire or flame.

A great gap still exists between the current IES recommended levels and minimum illumination found on home task planes lighted by a well-engineered portable lamp, even after general illumination from the more typical techniques is added (Fig. 2). Test experience and recognition of lighting performance of the majority of residence portable lamps and luminaires point up the need for restudy and reinterpretation of the 1959 footcandle recommendations for home tasks.

Illumination gains of the order provided by the new lamp, however, represent significant progress in this field.

(Abstract of IES Conference Paper No. 17.)

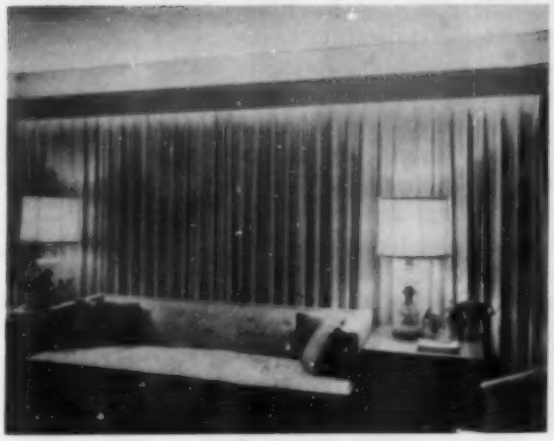


Figure 2. When installed, this attractive combination of valance, three 40-watt Homeline tubes and harp-type lamps with 150-watt, two-level lamps meets the IES recommendation of 30 footcandles for casual reading. However, this level cannot be maintained beyond 40 per cent of the tubes' lives, nor can a lamp higher than 150 watts be used in the high transmission shades.

Ceramic Multilayer Multicolor Electroluminescent Lamp

I. E. Buck, Jr.

THE ELECTROLUMINESCENT lamp is an area source of light which requires very little installation depth. Ceramic dielectric electroluminescent lamps have been constructed on bases of various sizes and shapes. They have found application, for example, in instruments to provide self-illuminated panels and dials.

Basically, an electroluminescent lamp is a capacitor-like structure formed by sandwiching a thin layer of insulating material, in which an electroluminescent phosphor is embedded, between two electrodes. At least one of these electrodes must be transparent. Refinements in construction such as the inclusion of extra coatings to provide greater resistance to voltage breakdown, light reflecting surfaces and, in the case of ceramic lamps, adherence to the substrate, add substantially to the complexity of the lamp structure. Since each of the glass coatings used in ceramic lamps must be heat-fused in place, the maturing temperature of each glass must be equal to or, preferably, lower than that of the preceding coating, to avoid an overfired condition in the latter. Careful selection of individual thermal coefficients of expansion is necessary to prevent crazing of the glass. The composition of the glass in which the phosphor is embedded must be such that it exhibits desired electrical properties and does not damage the phosphor.

A multilayer structure, in which one emission layer is constructed directly over the top electrode of a preceding emission layer, involves additional difficulties with respect to firing temperatures and thermal expansion coefficients. However, the loss of light from the lower emission layer through absorption in the upper emission layer becomes a significant problem. Breakdown-protection coatings, similar to those which had been found desirable to provide adequate brightness and resistance to dielectric

AUTHOR: Westinghouse Electric Corp., Bloomfield, N. J.

breakdown in single-layer lamps, were too opaque to be useful in the multilayer structure. Consequently, a new breakdown-protection coating was developed which transmitted 65 per cent of the green emission of a lower layer while yielding adequate emission brightness and electrical breakdown strength in the upper layer. This coating consisted of a thin application of barium titanate bound by a small quantity of clear glass, followed by an overlay of a carefully metered quantity of clear glass. Each application was individually heat-fused in place.

The completed upper emission layer transmitted 39 per cent of the green light of the lower emission layer. Incorporation of a yellow-emitting phosphor into the upper emission layer, approximately 40 per cent as bright as the green-emitting phosphor in the lower emission layer, provided a multilayer structure capable of either green or yellow emission. At 120 volts and 400 cycles, brightness values were 1.6 and 1.3 fL for lower and upper layer lamps, respectively. Simultaneous emission from the green- and yellow-emission layers produced a near-white emission.

(Abstract of IES Conference Paper No. 16.)

Color of High-Pressure Mercury Lamps

C. W. Jerome

THE COLOR of a mercury arc is affected by the mercury vapor pressure, phosphors are used to supplement the emission, and filter coats are used to obtain special effects. Each of these factors is discussed and its effect on the color of high-pressure mercury lamps is shown.

The vapor pressure of mercury within a discharge is determined by its temperature. Devices with low specific power inputs operate at a relatively low temperature and, consequently, at a low mercury pressure. High-pressure mercury lamps obtain their high pressure by virtue of a high power input which results in a high operating temperature.

The high-pressure arc is richer in green and yellow than the low-pressure arc and the change in color from one to the other is continuous and gradual. Practical mercury lamps have a limited amount of mercury so that at their normal operating temperature all the mercury is vaporized. All the lamps measured have arc tube temperatures slightly above 600°C and have colors within a small range on the C.I.E. Color Mixture Diagram, as shown in Table I.

The visible radiation from a mercury arc consists of a few spectral lines in the visible region. Consequently, its color rendition is rather unsatisfactory for blue-greens and especially for reds and purples. Phosphors deposited on the inside of the outer jacket have been used to correct this deficiency. Two phosphors which have found extensive use for this purpose are: an ortho-phosphate (lamps with ASA color designation "/W") and a fluorogermanate (ASA designation "/C"). These contribute to the over-all color of the lamps. How-

TABLE I — Chromaticity Coordinates of High-Pressure Mercury Lamps.

Bare lamp at	Arc		Phosphor		Lamp	
	x	y	x	y	x	y
0°C	0.210	0.180				
100°	.244	.321				
200°	.259	.355				
300°	.270	.370				
400°	.282	.384				
500°	.295	.394				
600°	.307	.403				
Standard Lamps at Normal Operation						
H15GV	.302	.392				
H12GV	.330	.404				
H22KD	.306	.388				
H1LS	.311	.391				
H1LB/W	.311	.394	.434	.410	.350	.400
H1LB/C	.332	.436	.543	.314	.375	.410
H1GL/Y	.415	.568	.624	.373	.443	.542
H1GL/X	.335	.426	.600	.300	.390	.400

AUTHOR: Sylvania Lighting Products Inc., Salem, Mass.

ever, since their emission constitutes only about 15 per cent of the radiant energy of the lamp, their effect on color is correspondingly small. The Table gives chromaticity coordinates of the arc, phosphor and lamp for these combinations.

The high-pressure arc is an efficient, high intensity source which can be used with filters to obtain special color effects. Its line spectrum limits its usefulness in this respect, but good blue, green or yellow can be obtained by isolating the desired spectral lines. Two filters have found sufficient utility to warrant making them an integral part of the lamp. These are a yellow, which results in the lamp with the ASA color designation "/Y", and a purple, which results in a color designated as "/X". The effects of these filters on lamp color are as would be expected from their spectral transmissions, and are listed in the Table.

(Abstract of IES Conference Paper No. 25.)

Design and Application of Outdoor Fluorescent Lamps

W. J. Karash

A. L. Hart

NORMAL fluctuations in environmental conditions place severe performance limitations on fluorescent lamps in outdoor applications. The characteristic light output *vs* bulb wall temperature function of fluorescent lamps is asymmetric, with a slow fall-off in light output occurring at bulb wall temperatures above 100°F and a rapid fall-off below 100°F.

Constant light output over a wide range of environmental conditions may be obtained by maintaining constant "cold spot" temperature. Several possible solutions are outlined using either luminaire or lamp design or both.

Design and operating characteristics of jacketed and unjacketed T10 1.5-ampere lamps, the first designed specifically for outdoor applications, are discussed. These lamps, because of their high bulb

AUTHORS: General Electric Corp., Cleveland, Ohio.

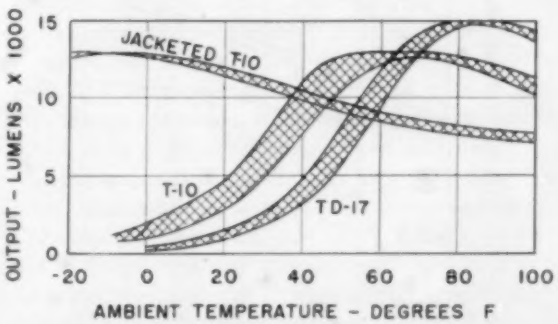


Figure 1. Light output *vs* ambient temperature for eight-foot fluorescent lamps in open, single-lamp floodlights. Wind velocities: 5-15 mph (lengthwise to luminaire). Commercial, two-lamp-series, outdoor ballasts. New, tightly fitting, weatherproof lamp holders.

Figure 2. Photograph of jacketed and unjacketed T-10 fluorescent lamps.

wall temperature, take advantage of the asymmetry of the light output *vs* bulb wall temperature function to produce: (1) reasonable light output over a much wider range of normal outdoor temperatures than previous designs and (2) highest light output at the lower end of the range where the longest periods of outdoor commercial operation usually occur.

Typical examples of outdoor and low-temperature applications for these two new fluorescent lamp designs are discussed.

(Abstract of IES Conference Paper No. 27.)

Lamp Performance Related to Reference and Commercial Ballasts

J. F. Gilmore

R. E. Hanson

Fill gas mixtures of two or more components are of continuing interest to the fluorescent lamp design engineer. This paper is concerned with the performance on reference and commercial ballasts of 40-watt T12 lamps having fill gas mixtures of neon and argon. Such mixtures result in improved efficiencies and increased lumen ouput relative to 100 per cent argon.

Neon content up to 50 per cent in argon-neon mixtures will not adversely affect starting, providing the fill pressure does not exceed three millimeters. Further improvement in efficiency and output of neon-argon mixtures can be obtained by reduction of fill pressure. The improvements measured on a reference (standard) reactor circuit are obtained also on commercial single-lamp and lead-lag ballasts, but not on commercial series rapid-start ballasts. For example, a 3.0-mm argon lamp operates on a typical series lead ballast at 94 per cent of the light output obtained on a standard reactor. This compares with 89 per cent obtained on a 2.0-mm, 60 per cent argon—40 per cent neon lamp. Moreover, the light output of the mixture lamp is 8 per cent higher on the standard reactor, but only 2 per cent higher on the series ballast. This tendency of lamps to produce lower ratios of light output on commercial ballasts than those obtained on a standard reactor increases with increase in neon content and with reduction in pressure.

Studies of voltage and current waveshapes of argon-neon mixture lamps indicated that, in order to narrow the margin between the standard reactor and the commercial ballast, the current waveshape should be improved to approximate a sinusoidal wave. It was found possible, with a simulated ballast, to approximate the same relationship between argon and argon-neon mixture lamps as was obtained on the reactor, at a flux density about half that existing in the commercial ballast. From our tests we have concluded that the commercial series ballast would have to be redesigned to a much

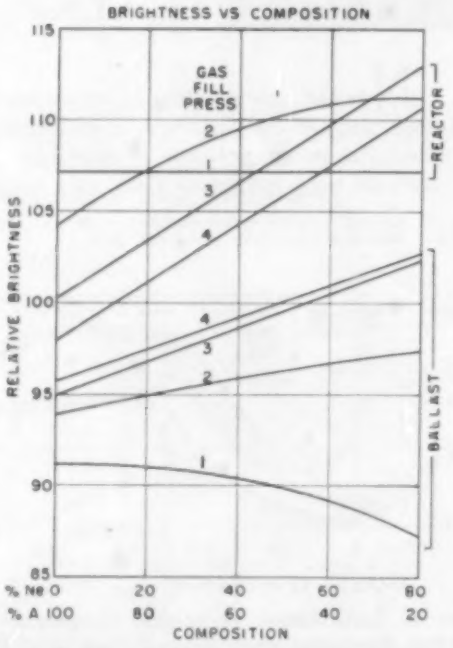


Figure 1. Output of 40-watt fluorescent lamp operating on reactor and series ballast circuits as fill gas composition and pressure are varied.

Authors: Westinghouse Electric Corp., Bloomfield, N. J., and Cleveland, Ohio, respectively.

greater size (and cost) to obtain with argon-neon mixture lamps the same relative performance between ballast and reactor as is obtained on argon lamps.

We have shown that mixed fill gases can be used to obtain higher output and efficiency. However, the operating characteristics of existing commercial ballasts in combination with lamp characteristics may result in poorer lamp performance than would be expected from reactor measurements. Lamp design engineers, therefore, must carefully consider ballast characteristics in altering or creating lamp designs and in the prediction of lamp performance.

(*Abstract of IES Conference Paper No. 35.*)

Multilayer and Flexible Single-Layer Electroluminescent Lamps

Robert J. Blazek

Robert W. Wollentin

Hans B. Bullinger

THE STRUCTURE of the electroluminescent lamp has been generally confined to a single emission layer in a single-lamp unit. The superimposition of a number of light emitting layers of various emission colors upon one another to form a multilayer lamp is of interest not only from an academic viewpoint, but also from a practical one, for application in instrument dial and panel lighting, as well as other applications where space- and weight-saving features are of importance. The flexible type lamp has the additional advantage of being able to conform to curved mounting and rotary drum arrangements for aircraft panel signaling devices. It can withstand severe vibration and is virtually indestructible upon impact.

This paper describes some of the technology pertinent to the fabrication of flexible base single-layer, and both rigid and flexible types of multilayer, electroluminescent lamps. General objectives with respect to structural considerations, performance in normal and adverse environmental conditions, and specific problems encountered in the development of such lamps are outlined.

Basically, the single-layer flexible lamp is constructed by the vacuum deposition of a thin metallic film (transparent electrode) upon a flexible plastic substrate, followed by spraying a thin layer of a phosphor-silicone alkyd mixture upon the transparent electrode and then "flashing" a back electrode of highly reflective aluminum. Polyethylene (medium and high density types) and polytrifluorochloroethylene in 0.005- to 0.010-inch film thickness can be expediently employed as flexible lamp substrates. However, the latter plastic is preferred on the basis of its exceptionally low water-vapor permeability, high thermal stability, clarity, and solvent resistance. Transparent electrodes of composited thin films of gold and iron oxide are preferable over electroformed nickel mesh, copper iodide and other types of thin metallic film systems. Films transmitting light to the extent of 60 to 70 per cent in the green spectral region with electrical resistivities of 15 to 80 ohms per square are readily achieved by the vacuum deposition of gold and iron oxide upon polytrifluorochloroethylene.

AUTHORS: Westinghouse Electric Corp., Bloomfield, N. J.

The deleterious effect of moisture ingress into the phosphor-dielectric layer on the maintenance of light output is minimized in flexible structures by employing heat-sealing techniques. Lamp performance is improved through the application of a flexible epoxy adhesive between the lamp substrate and protective backing (preferably a plastic of the same composition as the substrate) prior to heat-sealing the perimeter of the lamp. Thin wire or foil cemented to internal bus bars with electrically conductive epoxy are projected through the flexible epoxy fill and heat-sealed area to provide water-tight electrical lead-in contacts.

The basic multilayer structure contains three superimposed emission layers composed of green-blue- and red-emitting phosphors embedded in a plastic dielectric and separated by light transmitting electrically conductive films (intermediate electrodes). Various types of intermediate electrodes can be employed; *e.g.*, glass with tin oxide electrically conductive coating on both sides for rigid multilayer lamps, and metal mesh, thin films of copper iodide or gold, etc. for both rigid and flexible structures. In general, intermediate electrodes prepared by the vacuum deposition of composite films of gold and iron oxide are superior to the other types with respect to ease of application, uniformity and ultimate brightness of the emitting layers. However, unlike the deposition of thin films of evaporated gold on smooth plastic substrates, considerably thicker coatings are required for intermediate electrode applications to compensate for surface irregularities in the phosphor-dielectric layer. The light transmittance of the thicker gold iron oxide films required for satisfactory performance at 115 volts, 400 cycles range from 25 to 50 per cent.

Rigid type multilayer lamps are constructed on a glass substrate provided with a tin oxide type, electrically conductive coating. A cross-sectional drawing of the multiple structure is given in Fig. 1, where the prime coating and epoxy/aluminum protective backing are also indicated. The total thickness of the rigid lamp is approximately 0.10 inch along the edges due to overlap of the metal backing and 0.085 inch in the central area.

With the exception of substrate, protective backing and a few minor modifications, the flexible multilayer lamps were constructed in a manner somewhat similar to the rigid lamp counterpart. Fabrication techniques developed for flexible single-layer lamps were adapted to the multilayer structure. The total thickness of the flexible multilayer lamp, complete with protective backing, is approximately 0.030 inch. Both rigid and flexible multilayer lamp types are capable of emission in the red, blue, and green spectral regions, or in

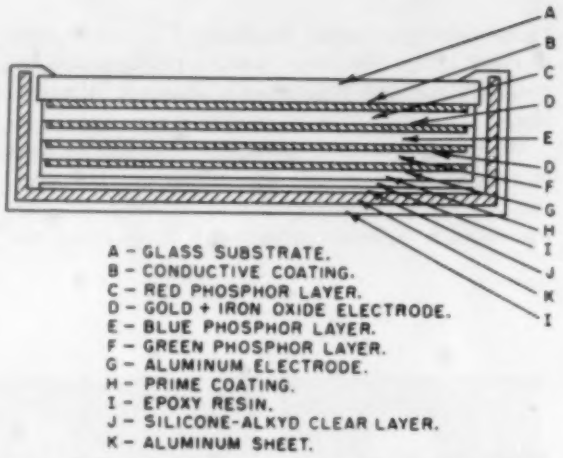


Figure 1. Cross section of rigid multilayer lamp (drawing not to scale).

combinations thereof, from a 6- by 6-inch area. Brightness values of a representative sample flexible multilayer lamp at 115 volts, 400 cycles are: 0.03 fL for the red top layer (nearest viewer); 0.03 fL for the middle blue layer and 0.10 fL for the bottom green layer. The brightness levels of the two lower emission layers are considerably lower than are observed for individual single-layer lamps of the same emission color and of equivalent voltage breakdown strength, due to the light scattering and absorption by the superimposed intermediate electrodes and phosphor-dielectric layers. A contributing factor leading to low brightness in the two upper emission layers is the absence of a highly reflective back electrode that is usually employed in a single-layer lamp. As a consequence, light emitted in the back direction is transmitted into underlying layers, where it is dissipated through absorption instead of being scattered or reflected back through the upper layers toward the viewer.

Evaluation tests of the rigid and flexible multilayer structures showed that their performances are nearly equivalent. No significant differences in the two types of lamps are evident with respect to their brightnesses, their ability to withstand high temperatures and their high-altitude performance. The rigid type lamp exhibited somewhat superior performance with respect to maintenance and ability to withstand high humidity operation; the flexible type lamps displayed somewhat better performance with respect to their ability to withstand low temperatures and vibration. In general, both the rigid and flexible multilayer lamps withstood specified environmental tests remarkably well.

(Abstract of IES Conference Paper No. 15.)

ROADWAY LIGHTING

Fluorescent Lighting for the High-Speed Expressway

W. J. McCormick

MONTREAL, Canada's largest city, will be traversed by a high-speed expressway which will be 32 miles long when completed, in about two years. Fig. 1 shows part of the completed section with service road and approaches in foreground. The specifications for the lighting system of this Boulevard call for a "sharp cut-off" fluorescent luminaire using two four-foot, 1500-ma, T12 extra-high-output fluorescent lamps.

The engineers for the Boulevard placed great importance upon uniformity and low luminaire brightness. No appreciable light was to be projected above the 70-degree angle and uniformity was to be 3 to 1, or better. Because of the northerly location of Montreal, important consideration had to be given to winter operation, with temperatures as low as minus 20°F on occasion and sustained periods of 0 to 15°F weather. Illumination intensities were not to be less than 75 per cent of maximum at minus 20°F with up to 25-mile-per-hour winds.

The completed section of the Boulevard is illuminated with about 1900 luminaires (supplied by a Canadian manufacturer) using a special low-temperature, T12 extra-high-output fluorescent lamp. The luminaire is a one-piece aluminum housing with the lamps placed well within the housing, thus confining the light output within approximately a

AUTHOR: Sylvania Electric (Canada) Ltd., Montreal, Canada.

Figure 1. Montreal Metropolitan Boulevard Expressway. Photo shows part of completed section with service road and approaches in foreground.

75-degree angle (see Fig 2). The light normally emitted above the 75-degree angle, which is the prime source of glare, is now directed down onto the pavement. The result is an increase in utilization of nearly 30 per cent over that of conventional fluorescent luminaires.

The low-temperature lamp in the T12 bulb is similar to the regular 1.5-ampere, T12 extra-high-output lamp, but has modified pressure control chambers. Regular fluorescent lamps, designed to give maximum light output at 77°F, are often not suitable for street lighting applications. The larger size of the sharp cut-off luminaire meant lower temperatures inside, and for good cold weather performance the low-temperature lamp is required. The low-temperature lamp gives maximum output at ambients of about 30 to 35°F and appears to be less sensitive to temperature variations.

The sharp cut-off luminaire, by controlling brightness, has provided a very adequate and comfortable lighting installation. The low brightness

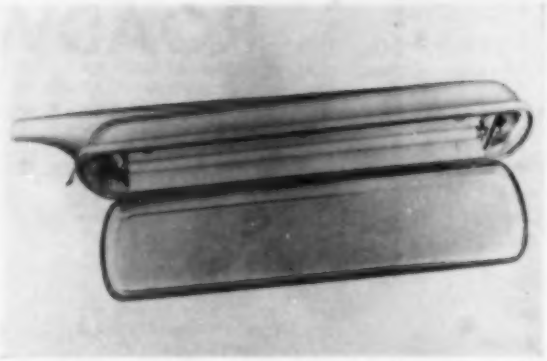


Figure 2. Shielded optical two-lamp fluorescent unit.

of the luminaire provides excellent driving comfort with intensities in accordance with recommended practice. The low-temperature lamps provide the necessary good cold weather performance.

(*Abstract of IES Conference Paper No. 33.*)

Factors Affecting the Efficiency of Street Lighting Systems

H. A. Van Dusen, Jr.

J. C. Yaeger

"To promote safety and convenience for vehicular and pedestrian traffic through adequate visibility during darkness" — with this cryptic phrase the major purpose of roadway lighting is described in the *IES Lighting Handbook*. Second in importance only to safety, adequate roadway lighting serves as a deterrent to crime, vandalism, and other acts of violence. If a roadway lighting installation is to effectively reduce accidents and crime, adequate levels of illumination must be maintained throughout the life of all of the components of the system and under all the environmental conditions that are indigenous to the particular geographic location in which the system is installed.

In the course of this discussion, the sole criteria for comparison of the effectiveness of a lighting system will be the incident footcandle level on the roadway. For purposes of simplification, all other factors which contribute to visibility, such as glare, reflectivity, uniformity, etc., will be eliminated.

To prevent any misunderstanding or misinterpretation of this discussion, it should be pointed out that it definitely is not intended to imply the superiority of any type of light source or lighting system. Rather, it is hoped that by compiling and discussing all of the factors that are likely to reduce the output of lighting systems (which are well known but often overlooked), lamp manufacturers, equipment manufacturers, and system de-

Authors: Line Material Industries, South Milwaukee, Wis.

signers will be inspired to take steps to improve the performance of future lighting systems.

Street lighting luminaires employing the three principal light sources in present wide usage are discussed on the basis of luminous efficiency of the minimum illumination utilized on the road as compared to the initial luminous efficiency of the light source. A ratio of the two previously-mentioned efficiency factors is defined as a figure of merit which can be used to compare the various lighting systems discussed.

There are many factors which prevent the figure of merit from reaching the ideal value of one. These are losses due to light not utilized on the roadway, lumen depreciation of the light source, voltage variation, dirt accumulation, ballast effects, environmental effects, and other factors.

Ironically the venerable series incandescent system usually approaches perfection to a greater degree than systems employing modern, highly efficient light sources. This is due mainly to the fact that although the light output of an incandescent lamp tends to decrease as the lamp ages, the wattage of the lamp operated on a series circuit increases in such a manner as to maintain the light output nearly constant. In addition, the small source size contributes to efficient utilization.

There are many areas which those involved might explore in order to improve the performance of street lighting systems. Sizeable gains in performance are potentially available, especially in systems using gaseous light sources. Very significant gains could be realized by improved optical system designs, improved lumen maintenance characteristics of some types of lamps and improved maintenance programs.

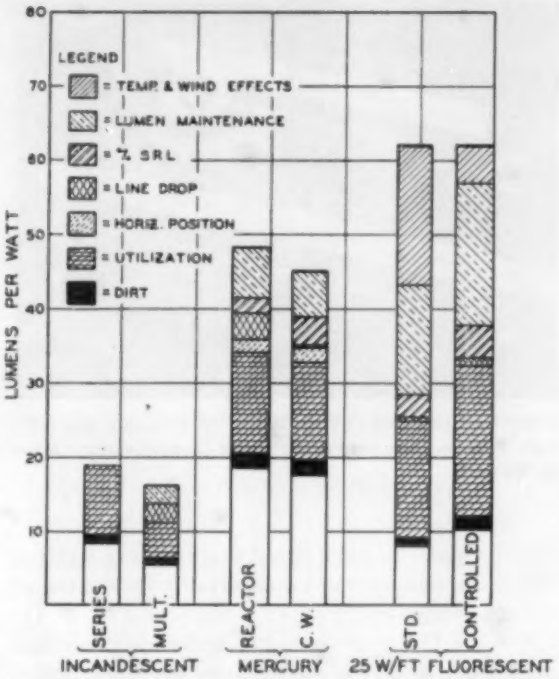


Figure 1. Comparison of efficiencies of street lighting systems. Unshaded areas represent lumens used on street at end of economic source life divided by input watts into luminaire. Values represent typical luminaires and will vary somewhat for various designs.

(Abstract of IES Conference Paper No. 32.)

The Application of Sodium Lamps to Public Lighting

J. B. de Boer

A REMARKABLE difference between public lighting in the United States of America and in western Europe lies in the choice of the light source. While sodium lamps are hardly used at all in America, in Great Britain, the Netherlands and Belgium, for example, these lamps are considered to be very important light sources for traffic lighting applications.

This situation has been brought about by the fact that the human eye sees better and more quickly, and is less troubled by glare, in sodium light than in the light produced by other light sources commonly employed for road lighting.

AUTHOR: N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands.

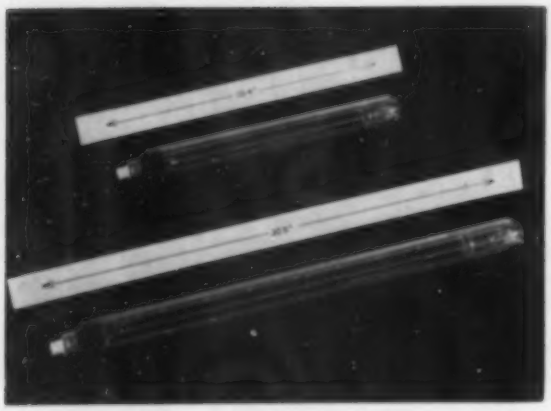


Figure 1. Integral sodium lamps of 200-watt and 400-watt ratings. For important lamp characteristics, refer to Table I.

Furthermore, we have found that roadway lighting can be carried out most economically by the use of sodium lamps.

Until a few years ago, the favorable properties of sodium light with respect to visibility, glare, etc., were known only from indoor investigations (Arndt, Bouma, König, Luckiesh, Weigel). In recent years, however, the author and his colleagues (Van Heemskerck Veeckens and Burghout) have carried out many series of observations in an open-air laboratory and on normal traffic routes, in addition to indoor tests.

The results of the studies can be summarized as follows:

a) For equal visibility, the road surface luminance with sodium light needs only to be ⅔ of that with mercury light;[1]

b) For the same degree of discomfort glare, the light source luminance with sodium light may be 1.5 times as much as the light source luminance with mercury light;

c) The road surface gives the impression of equal brightness when, with sodium light, the actual road surface luminance is only ¾ of that with mercury light.

The appearance on the market, in 1959, of sodium lamps in a very much improved form (luminous efficiency up to 112 lumens per watt, see Fig. 1) has considerably strengthened the economic motivation of the use of sodium lamps.

The appreciable saving in costs, achievable with these new light sources, is shown in Table II which provides, on the basis of the present average price situation in Belgium, Denmark and the Netherlands, the initial and running costs per mile of road. The savings become still more considerable if the lighting level for sodium light is taken to be ¾ of that of other light sources, a ratio which is certainly justified on the basis of the physiological tests mentioned above.

[1]By mercury light we imply here the light from high-pressure mercury lamps with fluorescent outer bulb.

TABLE I.

Lamp Rating	Lumens Per Watt at 100 Hours	Lumens Per Watt at 4000 Hours	Nominal Life in Hours
200 Watts	112	104	5000
140 Watts	100	90	5000

Table II shows that, in this latter case, approximately ⅓ of the total costs per mile per year can be saved if sodium lamps are employed in place of mercury lamps. Even if American kwh prices, which are often 2 to 2.5 times lower than the European prices, are employed in the calculations, there is still a saving of the order of ¼ of the total costs.

(Abstract of IES Conference Paper No. 10.)

TABLE II.

Case	I	II	III	IV	V
Light Type	Mercury	Sodium	Mercury	Sodium	Sodium
Level in Footcandles	1	1	2	2	1.5
Initial Costs Per Mile					
Cables and switching installation	15,300	13,820	15,300	15,300	15,300
Poles	7480	6810	8270	6810	5120
Luminaires and ballasts	4100	4250	5870	7010	5270
Lamps	795	604	1250	1208	908
Total initial costs (dollars)	27,675	25,484	30,790	30,328	26,598
Total initial costs (per cent)	100	95	100	99	86
Running costs per mile per year					
Maintenance	396	361	439	361	271
Lamp replacement and cleaning	443	551	686	1102	827
kwh consumption	1960	1033	3792	2069	1552
Total running costs (dollars)	2799	1945	4917	3532	2650
Total running costs (per cent)	100	70	100	72	54
Total costs per mile per year (dollars)[1]	5081	4066	7467	6119	4887
Total costs per mile per year (per cent)[1]	100	80	100	82	65

[1]Including amortization costs for cables, switching installation and poles (over 20 years) and luminaires and ballasts (over 10 years).

A. W. Fowle

R. L. Kaercher

Roadway Brightness and Illumination As Related to Luminaire Distributions

It is the authors' opinion that there cannot be a blanket substitution of brightness values for illumination values, or vice versa, for specifying roadway lighting systems. No one single illumination or brightness value (such as those plotted in Fig. 1) is a measure of the see-ability of a roadway lighting system. The relationship of one to the other must be considered. As was so well explained in 1914 by Dr. C. H. Sharp,[1] in a discussion of a paper by Dr. H. Ives, "It should be emphasized that brightness data and illumination data cannot be made to replace each other. They can only supplement each other."

Because there still is the problem of understanding how light flux distribution and system design can influence the brightness and illumination relationships, several systems were computed and examined with this problem in mind. It was concluded that it is difficult to give an exact meaning to a single ratio factor of roadway brightness/horizontal illumination because of the many influencing elements. Even if all of the elements could be taken into consideration and a ratio factor developed for each situation, these factors would still only be a means of transferring horizontal illumination to pavement brightness, or pavement brightness to horizontal illumination.

Since seeing is more a matter of brightness *contrasts*, the computed values of object brightness, pavement brightness and veiling brightness were combined to determine apparent contrast, C', for 12 systems that differed as to light distribution and spacing. To better understand the effects of different distributions, the individual illumination and brightness values, and resultant contrast values, were plotted, as in Fig. 1, to show graphically the relationships along one representative roadway line for each system. As there is as yet no practical means for easily measuring or calculating all the important quality elements of roadway lighting systems, the engineer must still rely to a large extent on experienced judgment in evaluating the relationships of pavement, object, background, and veiling brightnesses.

The authors believe that the type of data presented in this paper can assist design and application engineers in this respect.

Authors: Holophane Co., Inc., Newark, Ohio.

1. Ives, Herbert E.: "Measurement of Brightness and Its Significance," *Transactions of the Illuminating Engineering Society*, Vol. IX, No. 3, p. 183 (1914).

(Abstract of IES Conference Paper No. 31.)

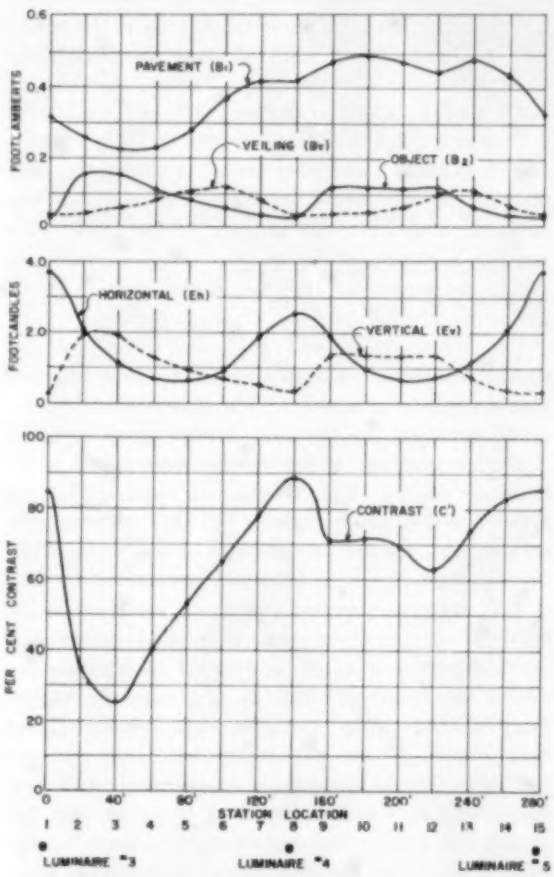


Figure 1. Pavement brightness, object brightness, disability veiling brightness, vertical and horizontal illumination and contrast for different positions along one representative roadway line. The system is horizontal 400-watt mercury lamps with 140-foot spacing and medium angle distribution.

Street Lighting Glassware Breakage

H. A. Van Dusen, Jr.

Breakage of street lighting glassware is quite serious. It is costly to replace and presents a safety hazard. Glassware breakage is not uncommon. The cause is usually thermal shock, vandalism probably accounting for less breakage than many people assume. Some years ago a research project was initiated to gather information that could be used to increase the reliability of glassware used in street lighting luminaires.

Cold rain striking the hot refractor of an operating luminaire causes thermal shock. The magnitude of/and factors affecting the ability of glassware to withstand such thermal shock, occurring in service, were the subjects of this research.

Information was obtained through consultation with glassware manufacturers, studies of the available literature, observation of many street lighting installations in service, use of many laboratory tests and a special outdoor testing laboratory.

Thermal shock breakage occurs when a surface of heated glass is suddenly cooled. The thermal contraction of the cooled surface is resisted by the adjacent warm interior portion of the glass, thus causing a tensile stress on the cooled surface. If the temperature differential is sufficiently great, the stress will be sufficient to cause failure.

The classical method for measuring thermal shock breakage resistance is to immerse heated glassware into cold water. The temperature differential between the initially heated glass and the water temperature is progressively increased until breakage occurs. The cooling rate obtained in this type of test is much higher than that occurring in service, and results of this type of test have often been at variance with observed performance.

A spray-type thermal shock test has been developed which correlates well with field experience. Controlled water spray is applied to a luminaire which has been operated at progressively higher lamp wattages until the glassware breaks. Exact field conditions are not duplicated; however, the test is related to the service environment and produces similar results. Fig. 1 is a comparison between test results and known service performance of a number of different types of luminaires.

The tendency of street lighting glassware to suffer thermal shock breakage in service is a function not only of the glassware, but is dependent also on the luminaire and lamp type. Some factors affecting thermal shock breakage are:

(1) Operating temperature and temperature distribution.

(2) The exposure of high-temperature areas of the glass to rainfall.

(3) Geometry of the glassware. The sharpness of prism root fillets is very significant.

(4) Mechanical stresses such as those caused by high clamping forces.

(5) The type of glass. Thermal stresses developed are dependent on the modulus of elasticity and coefficient of expansion and these vary for different compositions of glassware.

Street lighting luminaires can be designed to provide good glassware breakage performance in service, and this research has revealed some of the significant design factors involved. The test procedure provides a means for determining safe operating wattage value, as limited by glassware breakage characteristics, for various luminaires.

(Abstract of IES Conference Paper No. 30.)

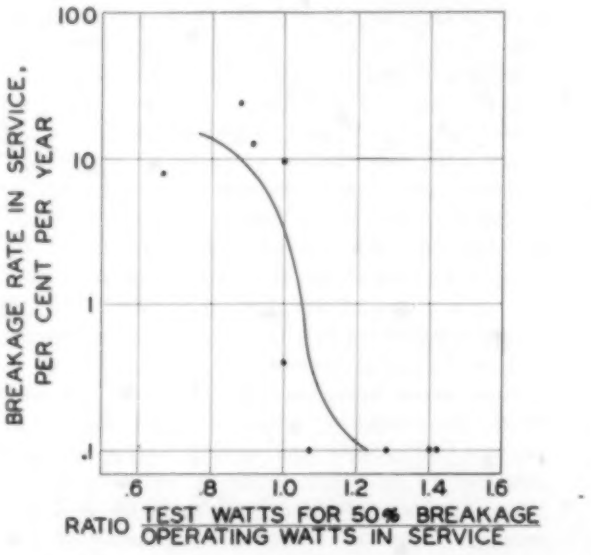


Figure 1. Comparison of service performance with spray test results. Each point represents the service record of 30 to 300 luminaires.

Author: Line Material Industries, South Milwaukee, Wis.

CALCULATIONS AND PHOTOMETRY

Photometry of Low-Mounted Linear Sources

By D. E. Spencer (right) and C. E. Kowalski*

*No photograph available.

OUTDOOR lighting calculations are conventionally based on candle-power curves. It is well known, however, that the concept of candle power is an exact concept only for point sources. For finite sources, apparent candle power may be operationally defined with respect to an arbitrary reference point within the source by multiplying footcandle readings by the square of the distance. In this sense, one will expect candle power to be a function of distance, which approaches a constant as the distance becomes very large.

The paper shows that for a low-mounted fluorescent luminaire, a family of apparent candle-power curves are indeed obtained as a function of distance. However, if the equivalent height of a rectangular source is calculated as a function of angle, the entire family of vertical candle-power curves coalesce into a single curve. Such a curve is shown in Fig. 1. Data obtained at distances from 2 to 40 feet are all represented by a single curve below the cutoff region. This curve itself can be determined from conventional candle-power measurements. Thus, extensive additional measurements are not needed to give information which is significant at all distances.

Specification of the luminaire in terms of effective height and effective width of an equivalent rectangular source has several advantages. A simple specification valid at all distances can be employed. From this specification, families of apparent candle-power curves can be calculated if desired. These are useful in predicting the appearance of perfectly diffusing surfaces.

To answer the more fundamental question of the appearance of imperfectly diffusing and semi-specular surfaces and the visual effect of the non-uniform surround, specification of candle power is not sufficient. What we need to know is how bright the luminaire is and what solid angle it subtends. The specification suggested in this paper is compatible with these long-range objectives.

(Abstract of IES Conference Paper No. 39.)

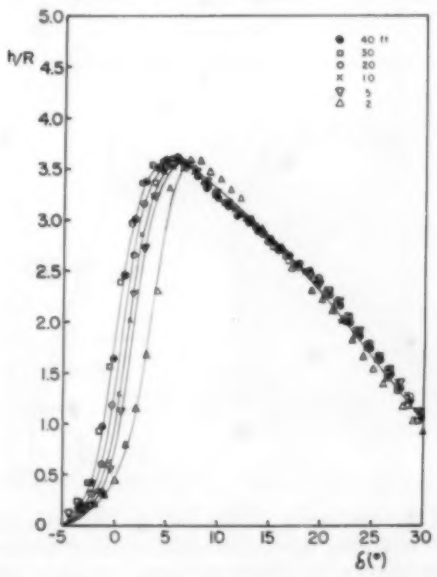


Figure 1. Effective height *h* of equivalent rectangular source *vs* angle δ below cut-off plane. R = lamp radius.

AUTHORS: University of Connecticut, Storrs, Conn., and Sylvania Electric Products Inc., Salem, Mass., respectively.

Computer Programming for Controlled Fluorescent Lighting

L. L. Montgomery

During the past quarter century, the Illuminating Engineering Society has shown keen interest in papers concerning better methods of computing, and in topics heavily dependent upon computations. We studied, or skimmed, many such papers with the conclusion that the authors of these papers, although they may not realize it, are the logical persons to program their results for electronic computers. There is a method of programming, called FORTRAN programming, which is quickly mastered and which will serve the purposes of the illuminating engineer who is computation minded. We can testify to this as a result of computer programs developed within the controlled fluorescent lighting program described in previous and concurrent IES papers.

The accompanying illustration (Fig. 1) is important in predicting illumination, and the described FORTRAN program for the IBM 650 is related to it. This program will be semi-nonsense material to most illuminating engineers but, we say, about three hours of tutoring will make it meaningful. An associated computer program for "all" right-triangle relationships ubiquitous in predicting illumination for layouts is illustrated by a sample page of answers (Fig. 2). We used the monumental IES extension of the Dewey Decimal System in classifying computer programs before sending their abstracts to the IBM 650 program library.

Library search saves research and, analogously, conventional and program library search aids plans for computer programs. We think the professional librarian is needed for this burgeoning field. The paper explains how this belief resulted, in part, from programming the IBM 604 for one of the parametric equations for the macrofocal parabola reflector.

(Abstract of IES Conference Paper No. 20.)

AUTHOR: Sylvania Lighting Products, Salem, Mass.

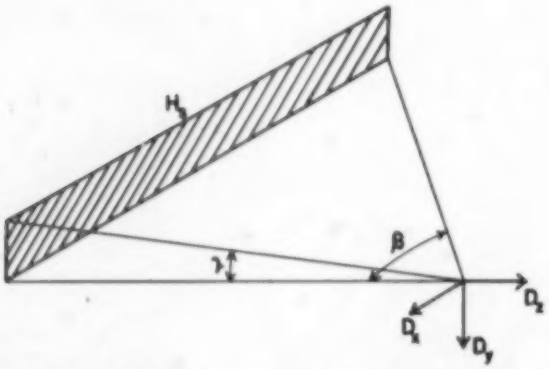


Figure 1. Canonical coordinates for the illumination vector for a strip source. Arbitrary point *P* is regarded as cornerline, if necessary by using "window subtractions." Illumination component D_z gives the illumination upon a plane which is parallel to plane of source.

b	a	c²	1/c²	c	1/c	b/c	a/c	arctan b/c
39	145	0022946	.00004	150.15328	.00665	.25973	.96568	
39	144	0022257	.00004	149.18780	.00670	.26141	.96522	
39	143	0021970	.00004	148.22280	.00674	.26311	.96476	
39	142	0021605	.00004	147.25827	.00679	.26484	.96429	
39	141	0021402	.00004	146.29422	.00683	.26658	.96381	
39	140	0021121	.00004	145.33065	.00688	.26835	.96332	
39	139	0020842	.00004	144.36756	.00692	.27014	.96282	
39	138	0020565	.00004	143.40502	.00697	.27195	.96230	
39	137	0020290	.00004	142.44297	.00702	.27379	.96178	
39	136	0020017	.00004	141.48144	.00706	.27565	.96125	
39	135	0019746	.00005	140.52046	.00711	.27753	.96071	
39	134	0019477	.00005	139.56002	.00716	.27944	.96016	
39	133	0019210	.00005	138.60014	.00721	.28139	.95959	
39	132	0018945	.00005	137.64083	.00726	.28334	.95901	
39	131	0018682	.00005	136.68211	.00731	.28533	.95842	
39	130	0018421	.00005	135.72398	.00736	.28734	.95782	
39	129	0018162	.00005	134.76646	.00742	.28939	.95721	
39	128	0017905	.00005	133.80955	.00747	.29145	.95658	
39	127	0017650	.00005	132.85330	.00752	.29355	.95594	
39	126	0017397	.00005	131.89768	.00758	.29568	.95528	
39	125	0017146	.00005	130.94273	.00763	.29784	.95461	
39	124	0016897	.00005	129.98846	.00769	.30002	.95393	
39	123	0016650	.00006	129.03487	.00774	.30224	.95323	
39	122	0016405	.00006	128.08200	.00780	.30449	.95251	
39	121	0016162	.00006	127.12985	.00786	.30677	.95178	
39	120	0015921	.00006	126.17844	.00792	.30909	.95103	
39	119	0015682	.00006	125.22779	.00798	.31143	.95026	
39	118	0015445	.00006	124.27791	.00804	.31381	.94948	
39	117	0015210	.00006	123.32882	.00810	.31622	.94868	

Figure 2. Right triangle calculations. The nomenclature is that of *IES Lighting Handbook*, Third Edition, Fig. A-31, page A-30. The IBM 650 was also used to print similar tables with "b" in inches and "a" in feet, these being convenient for low-mounted applications.

A. Hadley Taylor

A Portable Reflectance Meter

THE REFLECTANCE meter is a modernized version of the absolute reflectometer first described and demonstrated to the Illuminating Engineering Society by the author in 1920.[1] It employs a 4-inch integrating sphere and a small lamp and lens system mounted in a tube external to the sphere. By rotating this tube to either of two selected positions, the light spot can be projected onto the test surface, placed over a 1¼-inch opening in the sphere, or onto the sphere wall.

The light is measured by means of a phototube and amplifier, with light from a small spot on the sphere wall focused onto the phototube. By means of color correction filters, the reflectance values measured are applicable to a 4300-degree source (cool fluorescent lamps).

AUTHOR: Retired Physicist, Cleveland, Ohio.

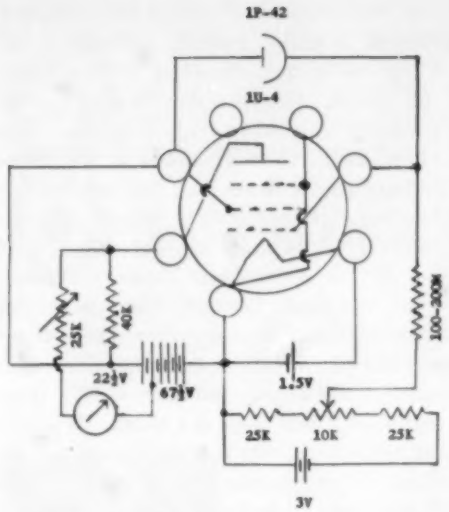


Figure 1. Simplified wiring diagram of amplifier. A selector switch makes it possible to measure battery voltages.

1. Taylor, A. H.: "A Simple Portable Reflectometer of the Absolute Type," Transactions of the Illuminating Engineering Society, Vol. XV, p. 811 (1920).

(Abstract of IES Conference Paper No. 38.)

Significance of Numerical Results of Photometry

E. H. Salter

IT HAS not been uncommon to find the results of photometric measurements of lamps and luminaires, and of computed data derived therefrom, such as coefficients of utilization, expressed numerically to four apparently significant figures. Considerable doubt exists as to the validity of this practice, especially where such values are the result of a single test of a single specimen.

The light source under measurement, instrumentation, and measurement procedures are such that exact duplication of results can be expected only under exact duplication of all conditions entering into the measurement. Most lighting equipment is such that exact duplication of conditions in repeated tests is difficult to obtain. Repeated measurements of the same specimen of even the more stable types of sources will show variations as great as ±¼ to ½ per cent; in the case of luminaires, this variation between repeated tests of the same unit will become as great as ±2 per cent.

AUTHOR: Electrical Testing Laboratories, Inc., New York, N. Y.

To this variation due to limited accuracy of measurement, is added possible variability due to lack of representative character of the specimen or sample tested. Where a large number of specimens, properly selected to truly represent the universe from which they are chosen, are tested, a true average performance can be developed. On the other hand, where only a single specimen is measured, variations from average will sometimes approach 10 per cent. Data showing typical examples of variation between test specimens of supposedly identical units are offered to verify this.

Coefficients of utilization, and other derived data, can represent the average no more closely than the test results on which they are based. Where such data are computed from a given single test result it becomes rather obvious that third-place figures lose all significance and second place figures become somewhat doubtful. It is then equally obvious that basing the choice of a luminaire for an installation solely on a small difference in luminaire efficiency or coefficient of utilization is not wise, since the average of the luminaires as supplied may deviate markedly from the single unit tested. Those who use such data should be aware of these facts.

This disclosure may raise a question as to why tests are made when the results are subject to such limitations. This, in turn, raises a question as to whether no information is as good or better than that which can be obtained economically. The answer is that testing, even with all its limitations, brings out worth-while data that cannot be obtained in any other manner.

(Abstract of IES Conference Paper No. 19.)

D. E. Spencer

L. L. Montgomery

Interflections in Aperture Lamps

The paper develops the integral equation for interflection of light within an aperture lamp. An exact solution of the integral equation is obtained, which permits the prediction of the photometric characteristics of aperture lamps. As shown in Fig. 1, within the aperture the lamp may be several hundred per cent brighter than conventional lamps. It is also shown that, with suitable reflecting materials, a major part of the luminous output of the aperture lamp is radiated through the narrow slit.

It is now possible to make lamps many times brighter than conventional fluorescent lamps, with no increase in power input. This gain is effected by interflections within the lamp. A cylindrical fluorescent lamp is employed, but instead of coating the entire surface with phosphor, a long narrow aperture is left clear. The remainder of the lamp is coated with a highly reflective phosphor layer. In this way, aperture lamps provide a very bright, narrow, one-sided light source.

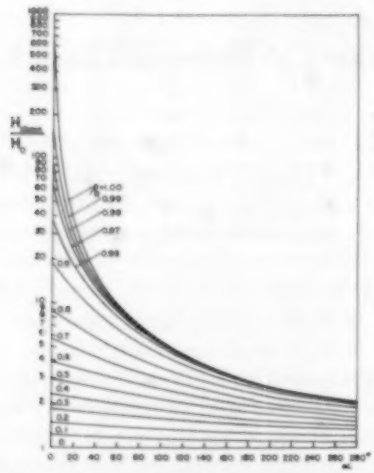


Figure 1. Graph showing how much brighter the inside of the aperture lamp is with interflections than without interflections. α = aperture angle, ρ_R = reflectance of lamp coating.

AUTHORS: University of Connecticut, Storrs, Conn., and Sylvania Electric Products Inc., Salem, Mass., respectively.

With such a lamp, fluorescent luminaires providing a high degree of control are possible. The theoretical characteristics of a family of reflector-lamp combinations are described. The advantages of the very bright aperture lamp may be employed either to reduce the size of reflector required, or to reduce power input. Either way, the aperture lamp provides greater economy in controlled fluorescent lighting.

It is hoped that the aperture lamp will be employed in a broad range of applications including automobile headlights, floodlighting of runways, bridges, walls, ceilings, low-mounted street lighting, cove lighting, indirect lighting, and even in the design of shallow luminous ceilings and luminous walls.

(Abstract of IES Conference Paper No. 22.)

Left to right:

G. A. Horton
R. R. French
John B. Arens

Photometry of Luminaires Using Highly-Loaded Fluorescent Lamps

Fig. 1 is one view of the calibration set-up showing the lamps being energized from the ballast in the luminaire to be photometered.

(Abstract of IES Conference Paper No. 41.)

HUGE photometric laboratories have usually been required for adequate testing of fluorescent luminaires. This paper describes the design and construction of a so-called "point source" photometer in which adequate test distances for eight-foot luminaires in normal burning position may be obtained within a nominal ceiling height of 12 feet. Coefficients of utilization calculated from these test results, compared with actual measurements of the luminaires in an Interflectance Room, check out its accuracy.

For the cases investigated, it appears that shorter photometric test distances using cosine-corrected photocells may be satisfactory for interior installations when luminaires are mounted at a distance equal to their own length or less, while for luminaires mounted at greater heights, a photometric test distance of five times the luminaire length may be preferred.

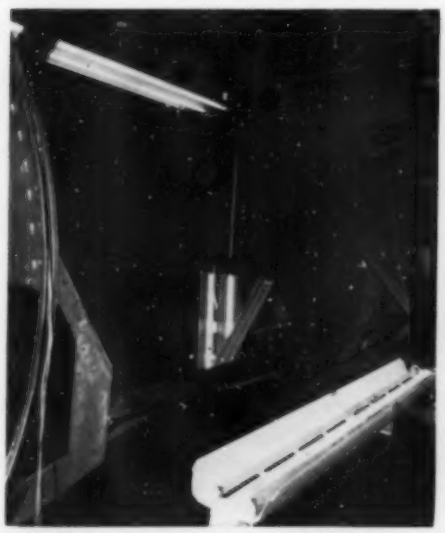


Figure 1. View of calibration set-up showing lamps energized from test luminaire ballast.

AUTHORS: Westinghouse Electric Corp., Cleveland, Ohio.

Left to right:

Robert W. Wollentin
Stanley R. Goldfarb
D. Clifford Bell

Electroluminescent Lamp Brightness Measurement

THE RECENT acceptance by commercial and military organizations of electroluminescence as a source of illumination has emphasized the importance of accurate brightness measurements of these sources.

Since the authors have found the Spectra Brightness Spot Meter (Model UB ½, with an external meter) to function with an acceptable degree of reproducibility, and since this instrument is in wide use as a measuring tool for electroluminescent light sources, this paper is concerned with the problems involved in adapting this instrument, through a calibration procedure, to accurate determination of electroluminescent source brightness.

The calibration procedure recommended herein considers first the standard approach for calibration of the instrument to a standardized white source, followed by an appraisal of its deviation from eye sensitivity through the use of filter photometry. This procedure, when applied to several Spectra Brightness Spot Meters, disclosed that the internal filter-photocell combinations generally closely matched eye sensitivity over most of the spectrum. However, in one of the meters examined, rather wide deviation from eye sensitivity was found, which emphasized the importance of calibration for various colors.

While it is possible to determine color by several methods, the one recommended is based upon filter photometry, where the Spectra Brightness Spot Meter is supplemented with selected filters which broadly cover the visible spectrum. The ratios of the instrument responses through the various filters provide identification of the color of the light source which then permits selection of the proper correction factor to be employed.

Besides the problem of color encountered in the measurement of electroluminescent lamp brightness, several other considerations peculiar to these light sources are of importance. The major problems are the variation in the brightness of the emitting surface area of the lamp and the sensitivity of lamp brightness to exciting voltages, frequencies, and temperature during operation. Proper control of these variables during lamp operation is mandatory. In the interest of reporting meaningful brghtness values, it is necessary to state the conditions of temperature, voltage, and frequency at the time of measurement.

(Abstract of IES Conference Paper No. 40.)

AUTHORS: Messrs. Wollentin and Goldfarb: Westinghouse Electric Corp., Bloomfield, N. J.; Mr. Bell: Chicago Miniature Lamp Works, Chicago, Ill.

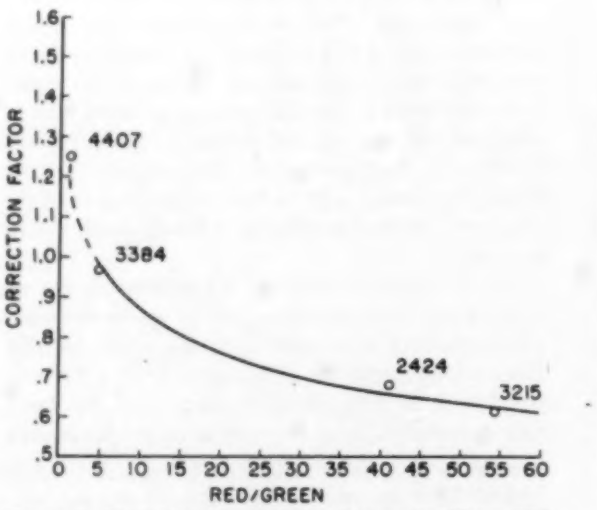


Figure 1. Variation of correction factors for Meter 084 with red/green ratio.

RESEARCH

Measurement of Visual Information Cues

H. L. Logan

Emanuel Berger

As THE object of the sight-light operation is to gain information of the world external to the observer, a method of measuring potential visual information recovery would be useful. Two identical scenes, for example, can be lighted with different lighting distributions to the same illumination level and can meet the same gross visual comfort criteria; yet, one scene can be clearer and sharper than the other. One scene can convey more visual information than the other, both along the avenue of attention where the data is consciously processed and below the threshold, where it is directed to nonmental terminals (resulting in the emotional component in the observer's response to the visual space).

As a luminous field with no changes is completely the same, and as information is conveyed only by changes, the reference condition adopted for this investigation is complete "sameness," or complete visual redundancy. It is measured by the autocorrelation function in the manner originally developed by Messrs. E. R. Kretzmer, C. W. Harrison and B. M. Oliver of the Bell Telephone Laboratories, and by means of the Kretzmer picture autocorrelator.

Four pairs of identical scenes with different lighting are reported upon in the paper. One pair (Figs. 1 and 2) shows the same street with different lighting methods employed. The autocorrelation curves (Fig. 3) show that the subtle difference in

AUTHORS: Holophane Co., Inc., New York, N. Y.

Figure 1. Uncontrolled street lighting.

Figure 2. Controlled street lighting.

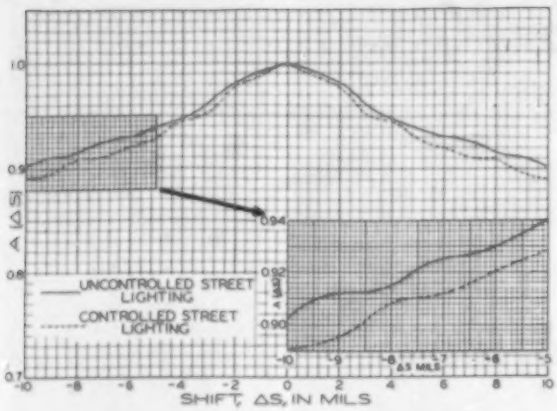


Figure 3. Autocorrelation curves for the two scenes in Figs. 1 and 2.

visual information revealed by the two pictures is measurable as a departure from "sameness."

The results for the four pairs of scenes studied are given in Table 1.

The data from such a few studies can only illustrate the nature of the problem being investigated. However, if our present suggestions cannot avoid the incompleteness of a progress report, they do demonstrate a technique for the measurement of visual information which, perhaps, opens a new perspective in lighting progress.

(Abstract of IES Conference Paper No. 11.)

TABLE I.

Scene	"Sameness"	Difference
Reference Field (Unity Autocorrelation)	10,000 A.C. "Points"	
Actual Bank Scene	9,289	480
Model Bank Scene	8,809	
Uncontrolled Street Lighting	9,461	181
Controlled Street Lighting	9,280	
Indirectly Lighted Classroom	9,568	121
Semi-Directly Lighted Classroom	9,447	
Reflected Glare Sample (5°)	9,653	57
Reflected Glare Sample (40°)	9,594	

Air Ions Using Ultraviolet Lamps

Rudolph Nagy

IONIZED air has been observed by many investigators working with ultraviolet lamps. The ultraviolet radiation from any ultraviolet lamp cannot directly ionize oxygen or nitrogen; the air ions observed are a result of attachment of electrons liberated from various metal surfaces or dirt particles.

A study was made to determine the number of negative air ions that can be generated by germicidal lamps. It was observed that many existing ultraviolet luminaires do produce a small number of negative air ions. Tests were made to determine which of the metals or combination of metals yielded the greatest number of ions from a given lamp. Further, a number of luminaires were designed and the number of negative ions measured. The number of negative ions was observed to be greatest in streamlined air flow and least in turbulent air. As many as 50,000 to 200,000 negative ions/ml can be obtained from such ultraviolet units.

The interest in air ions could open a new avenue of research in the application of germicidal lamps. There are many test results to show that negative air ions produce beneficial effects on humans while positive air ions are generally considered harmful. Germicidal radiation has recently made great strides in the field of air sterilization. Probably, the addition of air ions by proper design of the germicidal apparatus could greatly enhance the value of germicidal lamps in hospitals, factories and homes.

(Abstract of IES Conference Paper No. 42.)

AUTHOR: Westinghouse Electric Corp., Bloomfield, N. J.

BCD Appraisals of Luminaire Brightness In a Simulated Office

Willard Allphin

THE PROBLEM of discomfort glare has been studied by many researchers, and one of the criteria used has been BCD, the borderline between comfort and discomfort. Since most laboratory work in this field leads to calculations or assumptions about how people in work-a-day situations will react to discomfort glare, it seemed desirable to make an investigation under circumstances which are as close to a real-life situation as possible, without sacrificing the necessary standardization.

Is BCD a meaningful concept to most inexperienced observers? If so, can they make consistent and repeatable evaluations of actual lighting situations? It was the purpose of this project to ask these questions and, if the answers were "yes," to provide check-points against which systems for predicting discomfort glare can be checked.

Fig. 1 shows the simulated office, in which the twelve luminaires are switched in the combinations or "situations" shown in Fig. 2. In situation No. 5, the lighted row is the one farthest from the observer and nearest his line of sight. The observer looked at the fixation areas around the X's and adjusted luminaire brightness by pushing buttons which operate motor-driven dimmer equipment. Luminaire brightness range was 40 to 2500 fL.

Members of local organizations served as observers, and the fees were paid into the charity funds of the organizations. In addition, engineers (not lighting), supervisors, foremen and secretaries from the laboratory plant were used.

AUTHOR: Sylvania Lighting Products, Salem, Mass.

Figure 1. View of simulated office from behind observer.

Instructions were given from a tape recorder through the loudspeaker on the observer's desk, so that all observers would receive the same instructions in the same way. The observer was asked to push the upper button and notice that the "luminaires" got brighter. Then he was told to push the lower button and notice that they dimmed. He was asked to raise and lower the brightness several times and then to adjust the brightness to his BCD, the borderline between comfort and discomfort, while looking at the "X's."

Fig. 3 is a graphical presentation of the data from a highly consistent observer. It should be emphasized that the lines are not "curves" in the usual sense. In order to compare with data from other observers, the plotting is in the order of the arbitrary numbers assigned to the situations, but each observer made the appraisals in a different sequence. Fig. 3 simply shows the four BCD values in footlamberts chosen by the observer for each situation, and the outer points have been connected by lines in order to help in visualizing the spread of data. The dashed line connects the median values of brightness. Fig. 4 summarizes the data from 109 observers. Each curve relates percentage of comfortable observers to luminaire brightness for one of the situations.

The following are offered as conclusions:

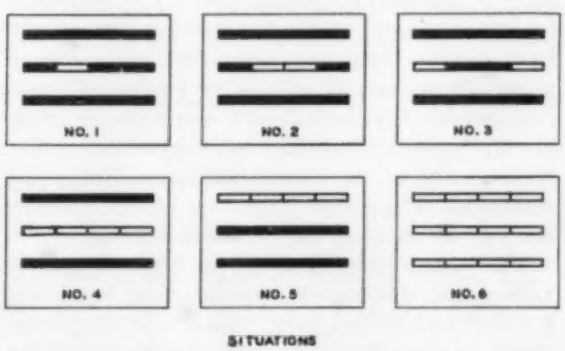


Figure 2. Situations. Open rectangles indicate lighted luminaires.

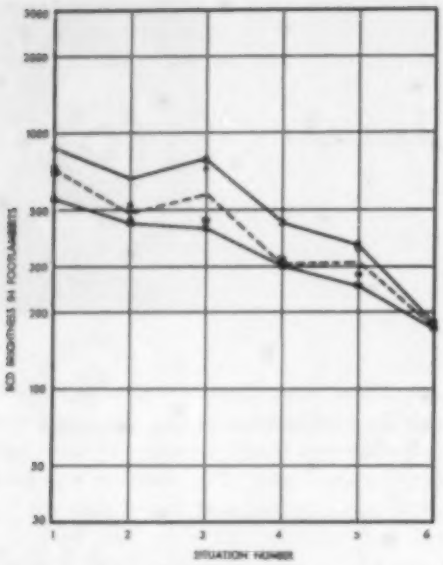


Figure 3. Example of consistent performance, Observer No. 42. Order of presentation: 3-4-6-2-5-1.

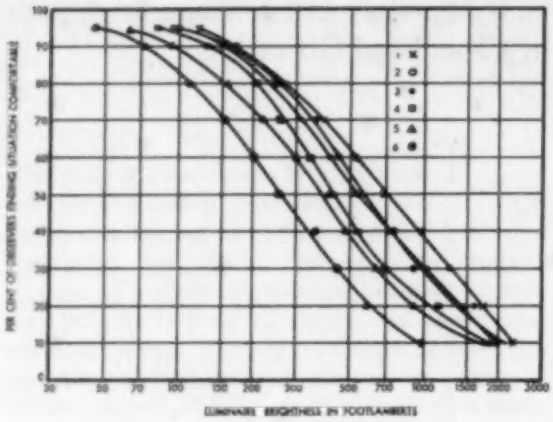


Figure 4. Per cent of observers finding each situation comfortable versus luminaire brightness.

(1) BCD is a meaningful concept to most inexperienced observers.

(2) Most such observers perform consistently when appraising the discomfort glare produced by an actual lighting situation.

(3 Consistent observers repeat their performance patterns on other occasions, but the patterns may be displaced upward or downward on the brightness scale.

(4) Observers differ considerably in the rate at which their adaptation changes with changes in luminaire brightness.

(5) Data are provided by which present and proposed methods of predicting discomfort glare can be checked for six simulated office situations.

(Abstract of IES Conference Paper No. 12.)

Further Data on Discomfort Glare From Multiple Sources

Sylvester K. Guth

John F. McNelis

THE PRIMARY objective of investigations of discomfort glare is to provide information which leads to the development of predicting, with reasonable accuracy, whether a lighting system will be acceptable. In spite of the considerable amount of work done on this subject, a number of questions remain unanswered and a completely satisfactory method of dealing with discomfort glare continues to be an elusive challenge. Important among these questions are those which concern large luminous areas and multiple sources.

The present investigation was initiated to provide visual discomfort evaluations with various combinations of luminous elements which correspond to those found in typical lighting systems (Fig. 1). These ranged from a full luminous ceiling to individual, lengthwise rows of luminaires in a simulated medium-sized room. Using previously described BCD procedures[1] and the Discomfort Glare Evaluator,[2] the various luminous areas were evaluated in terms of the brightness of a comparison source located on the line of sight. These sub-

AUTHORS: General Electric Co., Cleveland, Ohio.

Figure 1. View of the experimental condition representing a luminous ceiling (Condition A). The other conditions included various combinations of lengthwise rows. Comparison source is located on line of sight.

jective evaluations provide a basis for comparing computed discomfort glare ratings.

Subjective ratings can be in terms of the ratio of the comparison source brightness to the BCD brightness of the source on the line of sight (Comp/BCD), or as the index of sensation M_c of the comparison source, as shown in Table I.

Discomfort glare investigations have emphasized that glare effects are not directly additive. That is, computed ratings involving two or more sources have indicated greater discomfort than is shown by experimental observations. That additivity is probably a complex function is illustrated by the values of Comp/BCD and M_c. For example, Condition B is made up of Conditions D and E. Purely on a sensation basis, it can be said that B is equal to D plus E. However, the sum of the subjective ratings of the latter two conditions is considerably greater than the rating for Condition B.

Of the many methods for computing discomfort glare ratings which have been explored, several offer interesting possibilities. One of these is based upon the sum of the indices of sensation M of the individual luminous elements, which are shown as ΣM in Table I. It is seen that all of these values are greater than the corresponding subjective ratings M_c. An analysis indicates that these differences appear to be a function of the number "n" of luminous elements involved. Thus, ΣM can be related to M_c by means of a variable exponent "a." Computed values of $(\Sigma M)^a$, the exponent being obtained from a linear logarithmic relationship between "a" and "n", agree quite well with the subjective evaluations M_c.

Other possible methods involve converting each individual luminous element into an equivalent one located on the line of sight. Such conversions readily can be made by means of the BCD formula.[1] The sum of the individual converted sources is considered to be equivalent to the group of luminous elements included in each experimental condition. Ratings can be computed in terms of the ratio $\omega_o/\bar{\omega}_o$ in which ω_o is the solid angle of the equivalent source on the line of sight and $\bar{\omega}_o$ is the solid angle required for the same source to produce the BCD sensation. The ratings can also be in terms of $B_o/\bar{B}_o$ in which B_o is the brightness of the equivalent source and $\bar{B}_o$ is the BCD brightness of the same source. A third method is in terms of M_o, which is the index of sensation of the converted source.

Computed values of these ratings are given in Table I. The ratios $\omega_o/\bar{\omega}_o$ and $B_o/\bar{B}_o$ should be compared with Comp/BCD, and M_o with M_c. All may be represented by straight lines on logarithmic coordinates. Thus, the subjective and computed ratings can be represented by the exponential functions

$$\text{Comp/BCD} = 1.34\,(\omega_o/\bar{\omega}_o)^{0.37} = 1.13\,(B_o/\bar{B}_o)^{0.82}$$

and

$$M_c = 2.75\,M_o^{0.84}$$

This paper is a report of progress on the very complex subject of discomfort glare and should not be considered as presenting a preferred method for dealing with it. Needless to say, additional experiments are necessary to answer the many new questions raised by each new investigation. It is hoped that this new information will stimulate discussion and further analyses by those who are interested in the problem.

TABLE I — Experimental and Computed Discomfort Glare Ratings.

Experimental Condition		Subjective Ratings		Computed Ratings				
	Rows	Comp/BCD	M_c	ΣM	$(\Sigma M)^a$	$\omega_o/\bar{\omega}_o$	$B_o/\bar{B}_o$	M_o
A.	All	1.14	155	1606	152	1.73	1.44	154
B.	1-3-5-7-9	1.00	136	865	130	.86	.93	100
C.	2-4-6-8	.95	129	741	135	.87	.92	100
D.	1-5-9	.81	110	485	110	.44	.66	72
E.	4-6	.82	112	410	109	.61	.76	83
F.	3-7	.65	89	379	103	.42	.66	71
G.	2-8	.60	81	331	92	.27	.54	58
H.	5	.66	90	198	81	.28	.55	59
I.	3	.55	76	190	78	.21	.47	54
J.	1	.45	61	144	62	.082	.35	37

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(Abstract of IES Conference Paper No. 13.)

INSTALLATION AT S & K CHEVROLET, SOLANO AND FLORIDA STREETS, VALLEJO, CALIF.

Lighting a Used Car Lot

LIGHTING OBJECTIVE: To illuminate a used car lot for attraction and for merchandising purposes.

GENERAL INFORMATION: The lot, which is located on a corner, measures 125 feet by 130 feet. Sign type walls on two sides are yellow (65% RF). The lot pavement is black asphalt with cement worked into the surface (10% RF).

INSTALLATION: Four Nu-Art Lighting & Mfg. Co. catalog No. TNE-696-1500 MA open luminaires are mounted at the top of a round 30-foot pole located at the center of the lot, as shown in Fig. 2. Each of the luminaires is equipped with six 96-inch T-12 cool white 1500-ma fluorescent lamps.

One Nu-Art catalog No. AFF-448-1000 MA luminaire is mounted at the top of each of nine 15-foot poles spaced on approximately 30-foot centers on the two street sides of the lot. Each unit is equipped with four 48-inch T-12 cool white 1000-ma fluorescent lamps. The poles are set on the property line 15 feet back of the sidewalk. A cluster of six 150-watt PAR-38 flood lamps are installed at the end of a bracket arm mounted on each pole. These incandescent lamps illuminate and add sparkle to the grills on the front line of cars.

Footcandle readings after three months of operation were: base of center pole, 51 footcandles; property line, 20 footcandles; main show area (corner), 30 footcandles.

Figure 2. Daytime view of used car lot.

Lighting designed by Charles Michaelis, Pacific Gas and Electric Co., David Whitt, Electrical Contractor, Whitt Electric Service; and Arthur Kenny, Vice President, S & K Chevrolet, all of Vallejo, Calif.

Lighting data submitted by Charles Michaelis, as an illustration of good lighting practice and to aid in the design of similar installations.

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A.I.A. File No. 31

A.I.A. File No. 31

Views and Opinions

Footcandles Are Not Enough

Recently there has been a great deal of emphasis placed upon footcandles. Recommended lighting levels in most instances have been at least doubled, and in some cases tripled and quadrupled. This is a step in the right direction. Everybody instinctively wants more light and, as means are provided for producing it economically, acceptance is gained. But footcandles are not enough; we all know that there is another aspect of lighting which is equally important. This is the aspect which embraces such things as light distribution, shadows, contrast, glare, reflectances, textures and color, all of which are included in the word "quality"—an aspect for which we have no meter and where we must rely, to some extent, on judgment and experience. When the quality is wrong, the lighting is not good, regardless of the footcandle level. I would like to cite a few examples.

Public utility lighting men get in on a lot of post-mortems. When a new lighting installation isn't satisfactory, the owner sends for us. On the principle that the doctor learns more from a sick man than from a well one, we are very interested in such jobs. In offices, the complaint is almost always "too much light." We find perhaps 50, 70 or 100 footcandles on the task which we *know* is not too much light. We also find direct and reflected glare from unsuitable luminaires; lamps too close together, too-bright louvers or bottom covers, too-bright ceilings, inadequate shielding. These are some of the more common defects.

We have had complaints about luminous ceilings. When these are made of highly diffusing material, such as milk-white plastic, the brightness will often prove objectionable if we try to achieve a level higher than about 100 footcandles. Appreciably higher levels may be achieved with less highly diffusing materials such as crystal clear plastic with an embossed prismatic pattern to keep the light out of the direct glare zone or by a louvered ceiling with adequate shielding.

The lighting installation may not be the sole culprit. Put a sheet of white paper on a dark desk top and look at it under 10 footcandles. It should be quite comfortable. Increase the level to 100 footcandles and the paper seems unbearably bright; moreover, it loses stability and begins to float in space. A flat-textured, light-colored desk top will make things right again.

One reason for improved vision under higher footcandle levels is that the eye becomes more sensitive to brightness differences. This helps us to see detail more clearly but also imposes the restriction on the degree of contrast permissible in the general environment. As footcandle levels rise, brightness differences become more and more critical. If we neglect them and concentrate only on fixtures, customer reaction will often be "too much light." At high lighting levels we must specify not only the lighting installation but the complete environment, including reflectances and textures of all architectural and work surfaces.

In lighting for working, the objective is an efficient, comfortable visual environment. In lighting for selling, the objective is to attractively dramatize merchandise and identify the location. In recent years, architects and merchandising men have advocated the open front—a store front entirely of glass so the complete interior becomes a show window. We have received a number of calls on such jobs. The customer complains that people walk in hesitantly and say, "I wasn't sure you were open." We find, in such instances, strongly directional downlighting providing a relatively high level on the horizontal but no light on the ceiling and little on side walls. When one stands outside in front of the store in daytime, the impression is that of a black box. Wall and ceiling lighting plus high reflectances plus high intensity spotlighting on displays improve this condition. It must be discouraging to store designers to note in many of these open fronts a window sign—"open."

Showing the merchandise to advantage is another instance where footcandles alone do not offer a solution. A number of years ago, a jewelry chain relighted one of their stores in which the lighting had been unchanged for a long time. It consisted of multi-armed chandeliers equipped with bare, clear incandescent lamps. The new lighting was provided by semi-indirect equipment at a much higher level. Within a few months they noted an appreciable falling off in diamond sales. They retained a merchandising consultant who found that the soft, diffused, indirect lighting flattened out the diamonds which the glaring, bare lamps had previously filled with sparkle. Supplementary incandescent downlights over jewelry counters give right kind of light without glare.

Color of light is also important. We received a call from a hat store. "Women select a hat, walk to the mirror, put the hat down and walk out of the store," they said. We found a number of small mirrors hung on a wall of saturated green with a bare daylight lamp on each side. Lots of footcandles, but they walked out. A merchandise expert told us why. "When a woman looks at herself in a mirror, she looks at her face first. If she isn't satisfied, she forgets all about what she is trying on." A new wall color and the right lamp in a shielded enclosure corrected this condition.

Most people agree that an automobile looks best on a bright, sunny day. An overcast day deprives it, somewhat, of both modeling and sparkle. A car does not look its best in a showroom under a luminous ceiling of highly diffusing plastic, no matter how high the level. Additional, directional light should be provided for shadow, contour and sparkle.

Lamps are brighter than ever. Recently a contractor

called saying that he had never used 1500-ma lamps and wanted a check on his calculations. He was making a lighting plan for a supermarket and had convinced the owner to have 150 footcandles. He planned to accomplish this using continuous rows of bare lamp 1500-ma strip on a 9-foot ceiling. We suggested he hang up one of these lamps and look at it to convince himself it needed some shielding.

Not all our difficulties with higher levels are visual. Not long ago, we were called by a merchant whose 10-foot high store had been lighted to 50 fc plus with 150-watt recessed reflector lamps. Such lighting requires a loading of about 10 watts per square foot. Ten per cent of the energy appears as light and perhaps 70 per cent as infrared radiation which, along with the light, is efficiently transferred to the working plane by the reflector lamps. This merchant had artificial cooling which, of course, had little effect on this fine electrical heating system. He was puzzled that he felt cold at his desk in a corner and warm on the selling floor a few feet away.

Some lighting difficulties have a psychological aspect. A number of years ago, a utility installed a luminous ceiling in a control room. The diffusing plastic, when lighted, had a somewhat yellowish color. Side walls were finished in a hue whose brightness and color was a very close match for the ceiling. For the occupants of the room, the intersection of vertical and horizontal planes of walls and ceiling disappeared. This caused a feeling of marked uneasiness and instability. It was corrected by repainting the side walls in a pastel green differentiating their planes from that of the ceiling. A similar instance was encountered in a monumental government building in Washington where luminous, indirect luminaires were suspended in continuous rows in a room nearly a block long with the occupants' line of sight parallel to the rows. Nausea and dizziness were experienced by an appreciable percentage of the workers. No one liked the environment. Solution was the installation of a number of transverse baffles suspended at intervals from the ceiling, each baffle painted a different pastel color. This broke up the railroad track vanishing point effect of seemingly endless rows of luminaires.

These examples outline, to some extent, the scope of problems encountered in modern lighting. New light sources and equipment, together with the background of current visual research have opened a new horizon for the electrical industry. Pilot installations at the new levels are of first importance, but by concentrating on footcandles, to the exclusion of other factors, we may be guilty of "too much light" or "the wrong kind of light."

Some Solutions

With the new footcandle levels we need a complete reorientation on thermal environment. In the past, we have tended to deprecate the resultant heat from lighting. The heat generated at the new levels becomes so appreciable a factor that we can no longer ignore it or treat it as a necessary evil. It must be accepted and put to positive use as a part, or even a major part, of the building's heating system.

We need a new kind of training at several levels. The utilities, the contractor, the distributor's salesmen all have an opportunity to guide the small and medium-sized jobs. Larger installations are influenced by the architect, the consulting engineer and the manufacturer's representative. Something constructive is being offered these people at the local level chiefly by the utilities through IES courses—put on for those that will come. National contributions are being made by several Lighting Institutes under various auspices in different parts of the country.

The key man in the future of lighting is the architect and, unfortunately, we find him a hard man to sell. Architects must sell themselves; they resist conventional pressures. The AIA has 12,000 members; the various engineering societies, 500,000; a ratio of 40 to 1. This means that something like forty specialists, more or less, are working on each architect—each trying to convince him of the all importance of his particular field. No wonder the architect has a reputation of being a hard man to sell.

This might well be the time for a concerted effort on the part of all branches of our industry to rekindle the interest of architectural and engineering schools in adding lighting courses to their curricula. The architect is academically trained; the establishment of such courses in architectural schools would add considerable prestige to lighting in his eyes.

Specifically, we might consider an industry committee on lighting education with members from such organizations as IES, EEI, AIA, AIEE, NECA, NEMA. The scope of such a committee would be to find ways and means of establishing required courses on illumination in the architectural schools and in those options in electrical engineering which might naturally lead to consulting or general contracting work.

What might be the other activities of such a committee? I asked this question of a number of people of my acquaintance and the variety of ideas was decidedly interesting. Among them were:

(1) Establish lighting courses in technical institutes and junior technical schools.

(2) Establish national lighting design contests for architectural students taking required courses in illumination, with scholarships as prizes.

(3) Establish fellowship in post-graduate courses in advanced lighting work.

(4) Promote the distribution to architects and consultants of IES lighting data sheets, ILLUMINATING ENGINEERING, IES Recommended Practices.

(5) Promote joint local meetings of IES and AIA Chapters. Promote attendance of junior AIA members at local IES lighting courses.

(6) Promote formation of a national joint committee of IES and AIA along the lines of the present school committee but with a wider scope.

These came out in casual conversation. A brainstorming session would yield many more. If ten per cent proved practicable, a full-time executive secretary of such a committee would be a very busy man.—*J. F. Parsons, Illuminating Engineer, Niagara Mohawk Power Corp., Buffalo, N. Y.*

INSTALLATION AT LIBERTY FIRE CO. NUMBER ONE, NUMBER ONE HALL STREET, SPRING CITY, PA.

Lighting a Bowling Alley

LIGHTING OBJECTIVE: To illuminate a small bowling alley for recreational bowling.

GENERAL INFORMATION: This four-lane bowling alley, shown in plan in Fig. 2, is used by a Volunteer Fire Department. The ceiling height is 8 feet in the approach area and at the lowest points of the sawtooth-type ceiling over the lanes. Colors and reflectances of the major playing area surfaces are:

ceiling	white	70% RF
walls, plaster	white	80% RF
paneled	mahogany	30% RF
floor	maple	48% RF

INSTALLATION: The lanes are illuminated to a level of 125 footcandles by three rows of Keystone Electric Mfg. Co. fluorescent luminaires concealed in the sawtooth-type ceiling construction as shown in Fig. 2. Each row consists of two catalog No. SRP-496-4 industrial-type units, each equipped with four 96-inch T-12 cool white slimline lamps, and one No. SRP-448-4 industrial-type unit equipped with four 48-inch T-12 cool white slimline lamps.

The alley approach, scorers' and participants' sections are illuminated to an average of 25 footcandles by four Prescolite Mfg. Corp. catalog No. 2722 24-inch square recessed louvered units, equipped with 300-watt PS-35 silvered-bowl incandescent lamps, spaced as shown in Fig. 2. The spectator area is illuminated to 20 footcandles by two Prescolite catalog No. 2722-2 units

(over)

A.I.A. File No. 31*f*

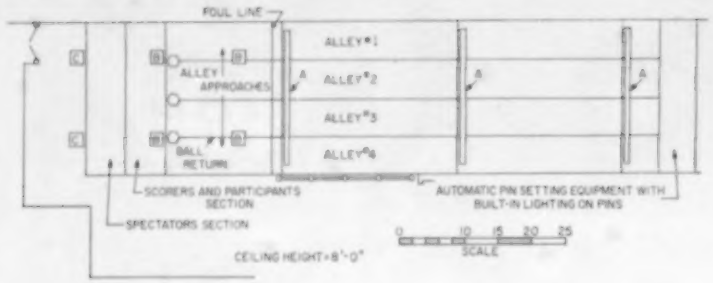

Figure 2. Plan view of bowling alley showing location of lighting equipment. A—Keystone fluorescent units. B—Prescolite 300-watt incandescent units. C—Prescolite 200-watt incandescent units.

equipped with 200-watt PS-30 silvered-bowl incandescent lamps spaced as shown in Fig. 2.

Brightness readings of the major surfaces at the time of illumination measurements were:

ceiling, spectator area	7 fL	floor	
alley area	42 fL	alleys	60 fL
walls, plaster	64 fL	approach area	12 fL
paneled	4 fL		

Lighting designed by Charles W. McQuiston, Lighting Engineer, Philadelphia Electric Co., Philadelphia, Pa. Electrical Contractor was Andrew A. Kurtas, Spring City, Pa.

Lighting data submitted by Charles W. McQuiston and George T. Anderson, Jr., Philadelphia Electric Co., Philadelphia, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

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LIGHTING NEWS

1960 IES Gold Medallist—Willard C. Brown

A distinguished name has been added to the list of IES Gold Medallists. With the unanimous approval of Council, the IES Gold Medal and Certificate has been awarded to Willard C. Brown . . . "for meritorious achievement which has conspicuously furthered the profession, art or knowledge of illuminating engineering." The award was made during ceremonies at the IES National Technical Conference in Pittsburgh this month.

This highest of all honors in lighting is the culmination of many previous recognitions of Mr. Brown's meritorious achievements. He was among the first IES members to be honored with the grade of Fellow. He has been elected President of several engineering organizations including the Illuminating Engineering Society (1941-1942), the Cleveland Engineering Society (1957-1958), and is currently President of the U. S. National Committee of the international illuminating engineering organization, the Commission Internationale de l'Eclairage.

The distinctive characteristic of Mr. Brown's contributions to illumination has been that in every phase in which he has worked (and these are numerous) a major advance in lighting knowledge and lighting practice has resulted. Many of these advances are detailed in numerous papers presented by Mr. Brown before this Society and published in its Transactions. Others are similarly outlined in the *Transactions* of the Society for Automotive Engineers and the American Society for Agricultural Engineers, the *Proceedings* of the CIE and many technical bulletins published by the General Electric Co.

Beginning in 1921, the year in which he presented his first major study (on operating temperatures of incandescent lamps and luminaires) before the IES Convention in Rochester, Mr. Brown has been a dynamic leader in such fields as automotive lighting, farm, sign and theatre lighting and all areas of commercial lighting. In automotive lighting he was for many years an active member of the IES Committee on Motor Vehicle Lighting and of the Lighting Division

Willard C. Brown

of the Society of Automotive Engineers. He was co-patentee (with R. N. Falge) of a basic principle of beam control by optical means from two-filament headlights. This principle still applies in modern headlights. Mr. Brown's further optical researches in headlamp design (with V. J. Roper) virtually revolutionized this field. One of the most notable of the major developments resulting from this work was the prefocused headlight bulb and greatly reduced headlight size.

In the theatre lighting field, he served as consultant for many of the largest and most spectacular theatres. He developed (with F. M. Falge) the principles for utilizing an individual reflector for each lamp in foot, border and strip lights. This equipment, still standard today, was reported in an IES paper in 1927.

Farm lighting was another of Mr. Brown's specialties during the early thirties. His work in this field led to his appointment as first Chairman of the Lighting Committee of the American Society of Agricultural Engineers. He authored the first bulletin on farm lighting which established principles of lighting for farm buildings and obtained ASAE approval of its recommendations. He specified the lighting for many early projects sponsored by the Committee on the Relation of Electricity to Agriculture, including the National Rural Electrification Project near Washington, D. C.

In the many phases of commercial lighting in which Mr. Brown has been active, he is best known for his work in the application of industrial lighting. He is credited with the first use of upward components of illumination in industrial lighting equipment and it was through his efforts that equipment for producing this effect became universally available.

Mr. Brown's lighting career has been in association with the General Electric Co., Nela Park, Cleveland, Ohio, which he joined in 1920. From 1948 to 1957 he was Manager of the company's Engineering Department. In this capacity he was responsible for the executive direction of efforts in all application fields, product planning and lamp performance. From 1957 until his retirement on March 31, 1960, he was Manager of Lighting Education. This included responsibility for the General Electric Lighting Institute and for educational programs designed for technical, professional and leading civic organizations, as well as for various user groups.

Paralleling Mr. Brown's distinctive career in these many phases of lighting has been his outstanding work with both the IES and the Commission Internationale de l'Eclairage. His leadership on IES committees, too numerous to mention, and with the U. S. National Committee of CIE for nearly 40 years has been, in itself, a major contribution to lighting progress. He also served on the Scope Committee of CIE which directs the technical activities and programs of the Congress.

Mr. Brown holds the rank of Captain on the retired list of the U. S. Naval Reserve, another area in which he has served with distinction continuously since 1917. He saw service in both World Wars, as Lieutenant with the U. S. Navy in World War I and during World War II as a Captain, USN, in charge of Commodity Procurement Activities.

Although he formally retired from active business last March 31, Mr. Brown plans to continue his work in illuminating engineering with characteristic vigor. In fact, he is just beginning a four-year term as President of the U. S. National Committee of CIE and is currently making plans for a major meeting of this organization to be held next month in State College, Pa.

Here and There With IES Members

Incoming and outgoing Section and Chapter officers and committee chairmen of East Central Region met with RVP Carman Miller and IES Managing Director Dex Hinckley (second and third from left, center row) for discussion of local activities for the 1960-1961 year. Meeting was held June 23-24 at the Yorktown Hotel, York, Pa.

Aerial tour of outdoor lighting installations in the greater Columbus (Ohio) area was high point of Buckeye Chapter meeting on street and airport lighting. Warren Edman, Holophane Co., Inc. was speaker at the "ground" portion of the meeting; Richard Eddy, Columbus and Southern Ohio Electric Co. narrated the hour-long aerial tour. Among the installations viewed by the 60 members and guests at the meeting were the new street lighting in Lincoln Village, a Columbus suburb, Lighting of Scioto Downs race track and strob-lighting on the main runway approach of the Columbus airport.

Membership certificates were awarded to new Sustaining Members at N. Y. Section's last meeting of 1959-1960 year. These most recent IES supporters are, l. to r. in photo at left: F. J. Walsh, consulting engineer; Sherman J. Lowy, Lowy & Donnath, electrical contractors; Fred Kasher, Spear Lighting Co. William H. Keen, section chairman (at right) made the presentations. In photo at right, Mr. Keen is the recipient of a certificate—in appreciation of his service as 1959-1960 section chairman—from incoming chairman Harold J. Peters (left).

Six New IES Fellows Elected

In recognition of their outstanding technical contributions to illuminating engineering, the following were elected to Fellow Grade by the IES Council.

G. B. Buck, Rocky Mountain Section
District Engineer, General Electric Co., Denver, Colo.

Accomplished in both research and application, Mr. Buck is credited with having played a major role in establishing the basis for fluorescent lamp colors, the development of the color- and cosine-corrected portable light meter and a general nomographic solution for the color of light resulting from the blending of light sources in any proportion. During the war, as a consultant to the U. S. Navy, he headed a research project on infrared and ultraviolet radiation under the direction of Admiral Hyman G. Rickover.

In the lighting application field, Mr. Buck has been a pioneer in the use of "on-the-spot" cost analysis for comparison of lighting systems, the design of a quartzline fixture for mine lighting and the problem of lighting for growth chambers.

Charles A. Douglas, Capital Section
Assistant Chief, Photometry and Colorimetry Section
National Bureau of Standards, Washington, D. C.

An outstanding physicist who has specialized in aviation lighting, Mr. Douglas is reputed to be the leading United States authority on the transmission of light through the atmosphere and its relation to the safety of air transportation. In connection with this work he developed an automatic atmospheric transmissometer and calibration equipment which provides continuous and reliable information on the visibility in the approach or touchdown area of an airfield. In his research on light signals, Mr. Douglas developed formulas and techniques for the measurement of the effective candlepower of flashing lights.

Mr. Douglas has been an active member of the IES Aviation Committee since 1954 and has served on the subcommittees for ground, runway and approach lighting.

O. Phelps Meaker, Cleveland Section
Senior Specialist, Advanced Application Department
General Electric Co., Cleveland, Ohio

Best-known for his original work on the problem of glare evaluation, Mr. Meaker was co-developer (with Dr. Ward Harrison) of the Harrison-Meaker Glare Factor Rating System, and of the extensively-used Visual Comfort Index. He is also an authority on photometry and testing procedures and has served, for many years as a member of the IES Testing Procedures Committee, including a term as chairman of the committee from 1957-1958.

Mr. Meaker has made valuable contributions to the study of lamp economics, among them the development of a "life meter" for demonstrating the influence of the various factors affecting lamp life.

In addition to his IES activities, he has served on CIE committees on Glare and Adaptation, Discomfort and Voltage Variation.

E. B. Noel, Cleveland Section
Manager, Incandescent Lamp Design Engineering
General Electric Co., Cleveland, Ohio.

One measure of Mr. Noel's notable achievements in the development of light sources is the number of patents he holds, some 33 in all which parallel the improvements in mercury, photochemical and photographic flash lamps. Among the developments to his credit, almost all of which have been documented in papers published by the Illuminating Engineering Society, are water-cooling jackets for high-pressure mercury lamps, a flash tube projection lamp, glass tube bending apparatus and an electric discharge lamp.

In recent years, as manager of his company's incandescent lamp design engineering section, Mr. Noel has directed much of the work in the improvement of incandescent sources and was in large measure responsible for the iodine quartz lamp introduced last year.

Philip F. O'Brien, Southern California Section
Associate Professor of Engineering
University of California, Los Angeles, Calif.

A pioneer in the application of computers to lighting calculations, Mr. O'Brien made one of the most significant recent contributions to illumination in the design and construction of the Luminous Analogue Computer for the prediction and synthesis of complex lighting problems. His work in the fields of heat transfer and optics led him to the application of the analytical methods of radiant heat transfer to lighting design. A research project on the spectrophotometric and colorimetric properties of chicken eggs and visual aspects of egg candling resulted in the design of lighting systems for egg candling.

At UCLA, where he is an instructor in lighting, colorimetry and photometry, Mr. O'Brien was influential in the organization of a radiometric and photometric research laboratory.

Rollo Gillespie Williams, New York Section
Lighting Consultant and Director of Color Research
Century Lighting, Inc., New York, N. Y.

An authority in two highly specialized areas of illuminating engineering—color and stage lighting—Mr. Williams has been responsible for the development of numerous devices for the control of color in lighting and for improvements in stage lighting equipment. He is the author of two widely-respected textbooks, *Lighting for Color and Form* and *The Technique of Stage Lighting*.

In application he has been one of the foremost "artists" of illumination as evidenced by his designs for the U. S. Pavillion at the Brussels' World's Fair, the Royal York Hotel, Toronto (Third Prize, 1959 MMILJ) and the lobby of 383 Madison Avenue, New York, an outstanding example of color change lighting.

He has served on many IES technical committees and is a Fellow of the British IES.

Julius Daniels Retires Honored at Testimonial Dinner

The retirement of Julius Daniels, one of the most beloved members of the lighting profession, from the Boston Edison Co., on June 30, was marked by a testimonial dinner attended by over 200 representatives of the New England electrical industry. Representing IES at this tribute to Mr. Daniels was incoming president Richard G. Slauer.

Mr. Daniels, IES President from 1931-1932, had been with the Boston Edison Co. since 1913 when he was in the cooperative program at Northeastern University. He was assistant to the general sales manager when he retired. During his 47 years with the company he pioneered in the fields of utility lighting service, air conditioning, industrial development and appliance merchandising. In addition to his activities in IES, he served as president of the Air Conditioning Bureau from 1936-1940, director of the Electric Institute and chairman of the Institute's lighting committee.

Julius Daniels is remembered by many IES members for his gallant victory over the paralysis which he suffered after a fall on the ice in 1947. After his recovery it was necessary for him to curtail his IES activities, but he was in attendance at most of the National Technical Conferences of the Society, including the 1959 Conference in San Francisco.

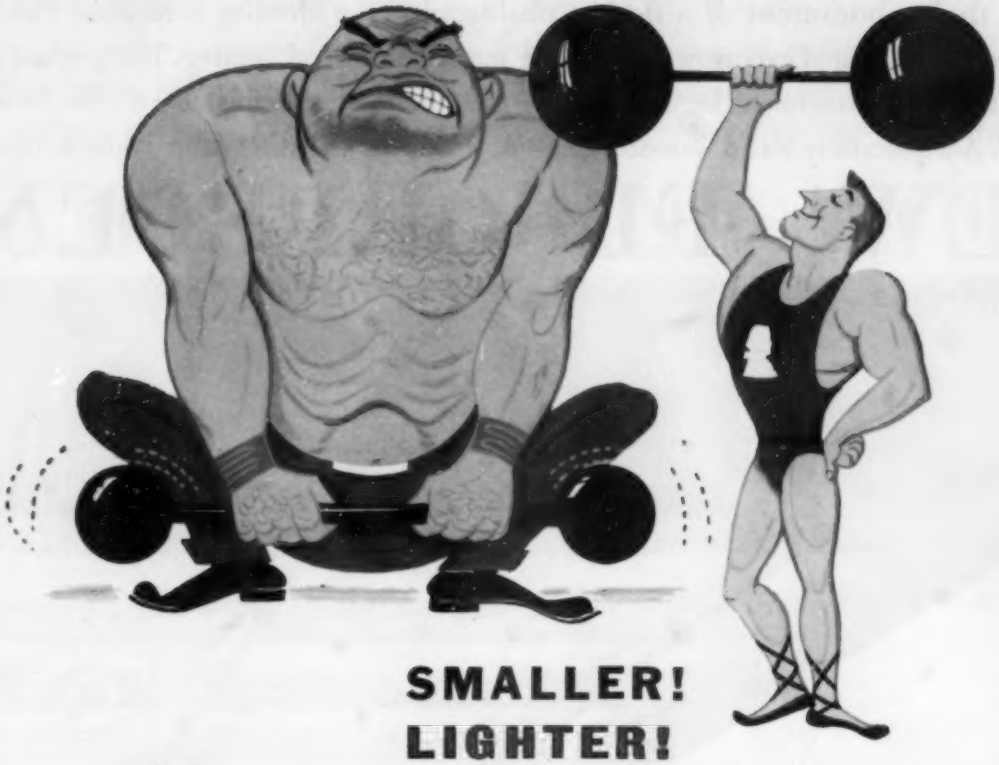
In addition to the testimonial dinner, on June 28, there was an open house in Mr. Daniels' office on the day of his retirement.

Research Project Devoted to Scientific Papers

A new research project at the Case Institute of Technology will be devoted to the development of a technique for determining the value of individual scientific

(*Continued on page* 14A)

AT AN "OPEN HOUSE" party in his office on June 30, the day of his retirement from the Boston Edison Co., Julius Daniels poses with gifts from many of his friends in the electrical industry. Mr. Daniels was assistant to the general sales manager of the company at the time of his retirement.



SMALLER!
LIGHTER!
but delivers MORE LIGHT!

new DRI·LOK ballasts for 1500 ma* lamps

It's Completely *NEW* . . . not a "face-lift" or a "new model" . . . but a NEWLY DESIGNED BALLAST that delivers more light output—yet is smaller and lighter (almost 5 pounds less, 2½ inches shorter, no increase in cross-section) than other ballasts now on the market for 1500 ma lamps. It's the first (and so far the *only*) 1500 ma ballast to meet new CBM requirements for 95% minimum light output. And it has a sound group rating of "D".

PLUS—DRI-LOK

These new ballasts positively *can't* drip compound. The exclusive DRI-LOK solid fill material is so stable it cannot soften or liquefy—cannot react or combine with any other material in the ballast. Core, coil and case are permanently bonded into a solid, voidless unit—assuring cool operation, long life and consistent uniformity. DRI-LOK fill is a *resilient* solid—with excellent sound-dampening qualities allowing a "D" sound group rating.

That's a lot of benefits for one new ballast—but here's the *best* news—you get them all at NO INCREASE IN PRICE!

the ballast

that can't drip compound

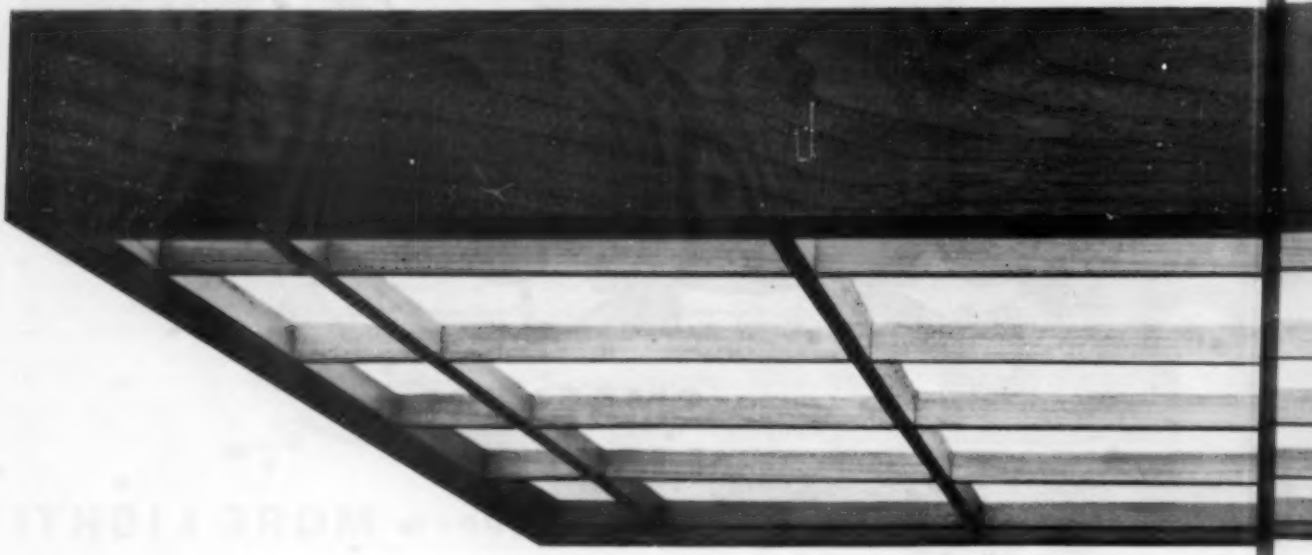
Your Jefferson man has all the details—call him!

*VHO, PG, and SHO lamps.

Jefferson DRI-LOK
New Blue FLUORESCENT BALLASTS
JEFFERSON ELECTRIC COMPANY • BELLWOOD, ILLINOIS

This is the embodiment of a design philosophy... a blending of function with aesthetics ... an imaginative application of appropriate materials to good lighting. The product is *Corona*, an appealing new treatment for fluorescents that transforms them into an effective decorative element. A wonderfully warm walnut frame surrounds the diffusing pane, while handsome birch

NEW! FLUORESCENTS



LIGHTO

Jersey City 5, New Jersey Showrooms: New York, Chicago, Dallas, Los Angeles

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ALABAMA
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Mayer Elec. Sup. Co.

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Stamford:
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DISTRICT OF COLUMBIA
Washington:
Morris Elec. Sup. Co.
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FLORIDA
Miami:
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GEORGIA
Atlanta:
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Englewood Elec. Sup. Co.
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Weston Lighting, Inc.

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Kansas City:
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Louisville:
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Baton Rouge:
Electrical Wholesalers Inc.
New Orleans:
Interstate Elec. Co.

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Bangor:
Standard Elec. Co.
Portland:
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Baltimore:
Estrella Public Serv. Corp.
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Boston:
Mass. Gas & Elec. Light Co.
Henry L. Wolfers, Inc.
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Springfield:
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Detroit:
Madison Elec. Co.
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St. Louis:
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Springfield:
Southern Materials Co.

MONTANA
Great Falls:
Glacier State Elec.

NEBRASKA
Lincoln:
White Elec.
Omaha:
Electric Fix. & Sup. Co.

NEVADA
Reno:
Western Elec. Distr. Co.

NEW HAMPSHIRE
Portsmouth:
Mass. Gas & Elec. Light Co.

NEW JERSEY
Atlantic City:
Franklin Elec. Sup. Co.
Cherry Hill-Delaware Township:
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baffles cut a pleasing modular pattern across its surface. The feeling is one of warmth and friendly informality . . . contemporary in styling, yet completely harmonious with traditional decor, residential as well as commercial. Optically, *Corona* is all that one might expect from a fine lighting instrument engineered by Lightolier. In four sizes: 54″ x 54″, 30″ x 30″, 32″ x 54″, 16″ x 54″.

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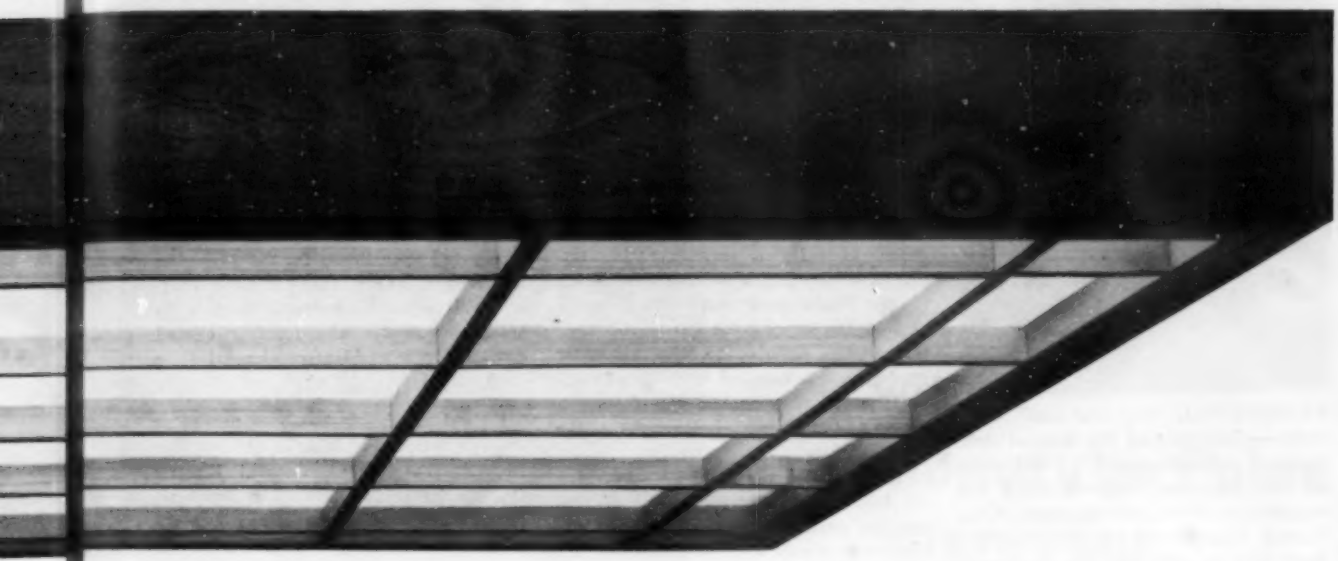

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Argo Life Studios
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Wally Elec. Sup. Co.
Reading:
Coleman Elec. Co.
Scranton:
Lewis & Reif, Inc.
Uniontown:
Pioneer Electric Dist.
Wilkes Barre:
Anthracite Elec.

RHODE ISLAND
Pawtucket:
Major Elec. Sup. Co.
Providence:
Leavitt Colson Co.

SOUTH CAROLINA
Columbia:
Capitol Elec. Sup.
Roland Co.
Greenville:
Sullivan Hdwe. Co.

SOUTH DAKOTA
Watertown:
J. H. Larson Elec. Co.

TENNESSEE
Knoxville:
Square Elec. Sup. Co.
Memphis:
Belvedere Lighting Co.
Nashville:
Nashville Elec. Sup. Co.

TEXAS
Dallas:
Rogers Elec. Sup. Co.
Ft. Worth:
Anderson Fixture Co.
Cummins Supply Co.
General Industrial Sup. Corp.
Houston
Groos Electric Supply
Martin Associates
Southern Electric Supply Co.
San Antonio:
Southern Equip. Co.
Strauss-Frank Co.

UTAH
Salt Lake City
Artistic Lighting

VIRGINIA
Arlington:
Dominion Elec. Sup. Co. Inc.
Roland Co.
Lynchburg:
Old-State Elec. Sup. Co., Inc.
Norfolk:
Roland Co.
Roanoke:
Roland Co.

WEST VIRGINIA
Huntington:
West Virginia Elec. Co.
Wheeling:
The Front Co.

WISCONSIN
Appleton:
Moe Northern Co.
Eau Claire:
W. H. Hobbs Sup. Co.
La Crosse:
W. A. Roosevelt Co.
Milwaukee:
Lappin Electric Co.
Standard Elec. Sup.

WASHINGTON
Seattle:
Seattle Lighting Fix. Co.

CANADA
Montreal:
L. D. G. Products, Inc.
The Gray Elec. Co.
Union Electric Sup. Ltd.
Quebec City:
La Cie Martineau Electric Co.
Toronto:
Revere Elec. Dist.
Toronto Ltg. Studios

TRADITIONAL "topping out" ceremony—placement of the highest steel beam of a building and the unfurling of the American flag—marked the completion of the steel structure of the United Engineering Center in New York City on July 26. The ceremony, evolved from an ancient custom to appease the wrath of the gods and bring good luck to a new building, was attended by representatives of the 18 engineering societies which will occupy the building. The UEC is scheduled for completion in the summer of 1961.

(*Continued from page* 10A)

papers. Motivated by a recognition of the need for more effective communication among scientists, and supported by a $16,800 grant from the National Science Foundation, the study, to be conducted during the next year, will be under the direction of Dr. Russell L. Ackoff, Professor of Operations Research of the Institute's Department of Management.

A team of scientists will analyze articles, published since 1900, in a variety of scientific fields; those equally evaluated will then be further analyzed to identify distinguishing quality characteristics. Two approaches to this aspect of the research will be employed.

The retrospection approach will seek a method of determining the value of an article from its history after publication; the theory that the value of an article is related to the rate at which it is cited over a period of time will be investigated. The prospection approach will seek criteria for predicting the value of an article before publication.

Mother Lode Section Establishes Stu Davies Perpetual Award

In honor of their beloved member, Stuart R. Davies, killed in an automobile accident in June, the Mother Lode Section has established a yearly award. The Stu Davies Perpetual Award will be presented to a Section member each Spring, on the basis of achievement and merit in the lighting industry. The Section has also made a donation, in Mr. Davies' name, to the United Engineering Center Building Fund.

Mr. Davies, an IES Member, was a charter member of the Section.

Engineering Graduates Find Full Employment Market

This year's engineering graduates continued to enjoy a very favorable employment situation, according to a survey by the Engineering Manpower Commission of Engineers Joint Council. Survey information, covering 15,000 engineering graduates, was supplied by deans of engineering and placement officers from colleges and universities throughout the United States.

The Commission's statistics, as of May 20, indicated that future plans of prospective graduates were divided as follows: 62 per cent with jobs, 11.3 per cent considering job offers, 8 per cent entering military service, 10.1 per cent entering graduate studies and 1.2 per cent with other specific arrangements. In all cases, these figures do not vary more than 1½ per cent from a comparable 1959 survey.

The full survey may be obtained from Engineering Manpower Commission, 29 West 39 Street, New York 18, N. Y., for 25 cents.

ABOUT PEOPLE

The election of **George C. Connor** as senior vice-president—marketing of Sylvania Electric Products Inc., has been announced by **Robert E. Lewis,** president of Sylvania. With headquarters in New York City, Mr. Connor will have over-all corporate responsibility for the marketing activities of the company's eight operating divisions. He succeeds **Barton K. Wickstrum,** who was recently elected executive vice-president of General Time Corp.

Robert H. Smith has been named as manager—manufacturing of the Outdoor Lighting Department, General Electric Co., Hendersonville, N. C. Mr. Smith replaces **Carl N. Brown,** who has been appointed manager of the G-E plant in Campinas, Brazil. Also announced by

(*Continued on page* 19A)

CITATION of appreciation for his "untiring interest, assistance and cooperation" in furthering the success of the first five lighting courses conducted in the Tampa, Fla. area is presented to Milton O. Hollis, Raybro Electric Supplies, Inc. (second from right) by James A. Banton (right), former IES Southeastern RVP and director of the lighting schools. Martin L. Harkey (far left) represented IES, Wallace Carothers represented the Florida Association of Electrical Contractors, co-sponsors of the course, at the presentation.

Oshawa Shopping Center,
Oshawa, Ontario, Canada.

Tip Top Mart, Canton, Ohio.

Sears, Roebuck Store, Tampa, Florida.

Southgate Shopping Center, Cleveland, Ohio.

Garden State Plaza, Paramus, N. J.

Area Lighting with Monotube Poles offers you unmatched design choice in steel or aluminum

Union Metal engineering assistance is available to help you select the most appropriate lighting pole design combining economy and good appearance.

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Monotube Area Lighting Poles

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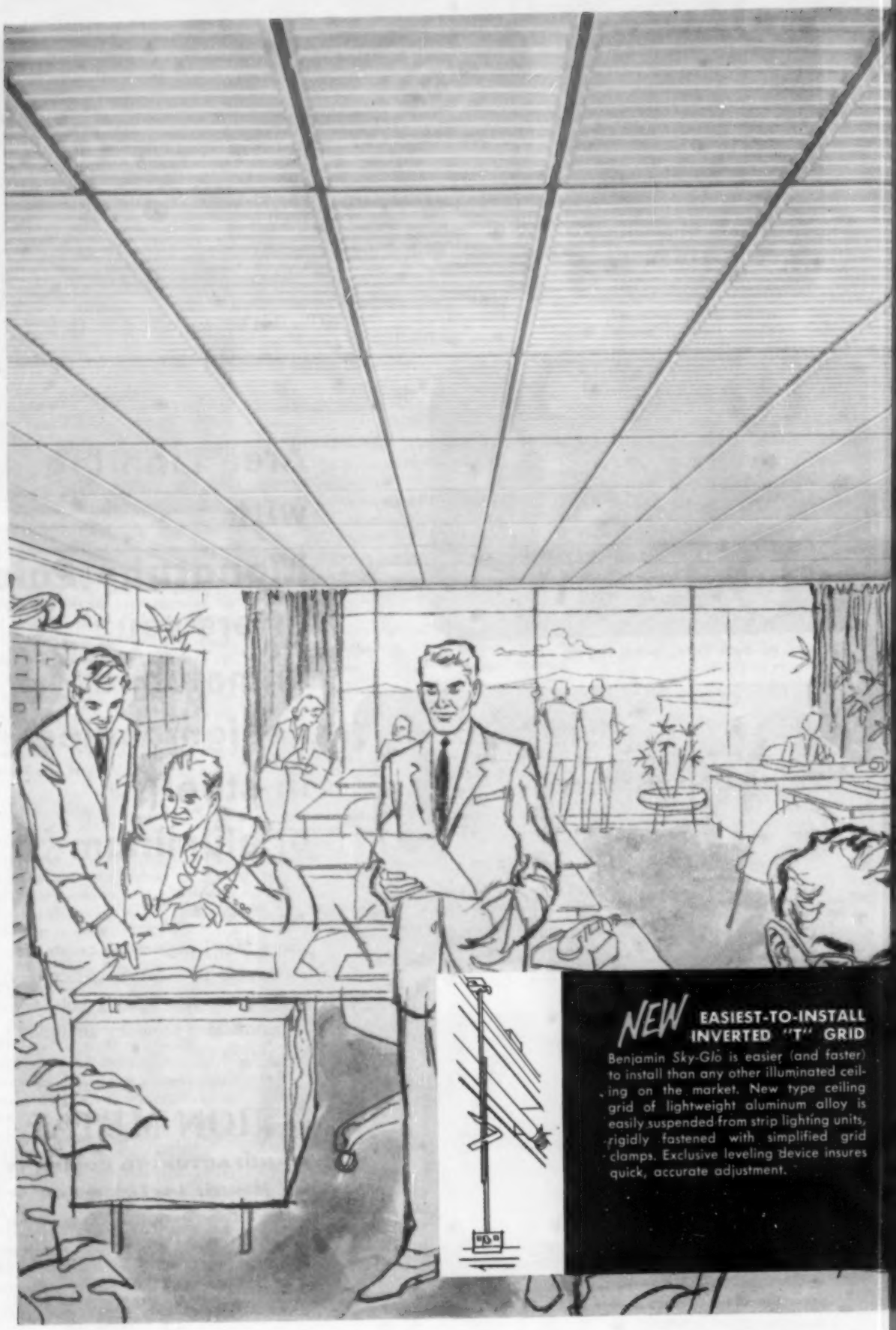
NEW
EASIEST-TO-INSTALL
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Benjamin Sky-Glo is easier (and faster) to install than any other illuminated ceiling on the market. New type ceiling grid of lightweight aluminum alloy is easily suspended from strip lighting units, rigidly fastened with simplified grid clamps. Exclusive leveling device insures quick, accurate adjustment.

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Sky-Glo brings you an outstanding combination of advanced features, based on the design and engineering experience possessed only by Benjamin—ORIGINATOR of the illuminated ceiling! Easily-installed 2′ x 4′ or 2′ x 2′ panels fit any room, are adaptable for acoustical treatment and air-conditioning requirements. Supplied complete with lighting equipment, with a choice of seven panels and standard or high output lamps. Investigate *Sky-Glo*—see for yourself how much more Benjamin offers.

ILLUMINATED CEILINGS

Bring you a new era in Service and Satisfaction

- HIGHER LIGHTING LEVELS
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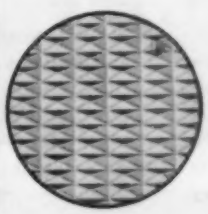
NEW
COMPLETE LINE OF LIGHTING UNITS

Another Benjamin exclusive!... *Sky-Glo* illuminated ceiling offers you Rapid-Start, Slimline, 800 ma. or 1500 ma. Power Groove lamps in a complete new line of fluorescent strips, featuring grooved channel, simple butt mounting and new ceiling spacer.



Angled facets of L-120 lens create high-efficiency diffusing medium.

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SELECTION OF PANELS

- Acoustical perforated vinyl panel
- Sculptured vinyl panel*
- Prismatic L-120 lens
- Polystyrene louver—½" cube
- Aluminum louver—½" cube
- Holophane prismalume #6024

*illustrated in ceiling on opposite page

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Architect:
Minoru Yamasaki & Associates

from HONEYLITE Luminous Ceilings*

Short-term obsolescence and costly replacement are eliminated with a HONEYLITE Luminous Ceiling because only HONEYLITE provides the trouble-free durability and permanence of light, strong aluminum honeycomb. With HONEYLITE overhead, the Reynolds Metals Company's new Great Lakes Region Headquarters is assured of shadow-free, glare-free lighting for many years to come.

HONEYLITE's aluminum, open-cell construction is responsible for its unique lighting performance and installation advantages. Completely fire-proof, HONEYLITE is listed by Underwriters' Laboratories, Inc. with a Flame Spread rating of Zero, a Smoke-Developed rating of Negligible. HONEYLITE is further listed by UL for installation *under* fire-sprinkling systems, permitting sprinkler, heating, air-conditioning and ventilating units to be concealed and integrated without loss of performance. Inherently non-static, HONEYLITE is dust resistant . . . requires only occasional cleaning *at a maintenance cost less than that required by an equivalent floor area.*

A wide range of HONEYLITE cell sizes, cut-off angles and finishes offers complete lighting flexibility for new construction and remodeling. For further information on HONEYLITE, today's most advanced luminous ceiling system, see the HONEYLITE Catalog in Sweet's Architectural File or write Dept. 9-H

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(*Continued from page 14A*)

G-E was the appointment of **Marvin L. Beck** as manager of manufacturing for the High Voltage Switchgear Department, Philadelphia, Pa. Effective August 15, Mr. Beck succeeded former manager of manufacturing **W. M. Anthony,** who has been named manager of works utilities for G-E's Philadelphia switchgear departments. In his new position, Mr. Beck will be responsible for the manufacture of such high voltage switchgear products as large power circuit breakers, outdoor station equipment and indoor generator bus conductors.

Aubrey G. Caplan, P. E., has left the Duquesne Light Co., Pittsburgh, Pa., after a fifteen-year association, to open his own office for the practice of electrical engineering. Mr. Caplan, whose new office is also in Pittsburgh, will be primarily concerned wtih the design and specification of commercial, institutional and industrial lighting, wiring, and related systems.

Fred S. Dubin Associates, Consulting Engineers, have announced the appointment of **Norman D. Kurtz** as engineering administrative assistant to the partners, **Fred S. Dubin** and **Harold L. Mindell.** Formerly with Westinghouse, Mr. Kurtz will handle administrative matters concerned with the firm's government and industrial practice. The concern presently has offices in Hartford, New York, Boston, St. Louis, Puerto Rico and the Virgin Islands.

Thomas Industries Inc., Louisville, Ky., has centralized all engineering functions under a new administrative department, in accordance with plans for future growth and expansion. Named to the new post of director of engineering was **Frank J. Marriett,** previously chief engineer of the Benjamin division in Des Plaines, Ill. Reporting to Mr. Marriett will be the chief engineers of the four division of the company, including Benjamin, Moe Light, Electric Sprayit and Wright Saw, who previously reported to the merchandising department with headquarters in Louisville. Mr. Marriett is succeeded as chief engineer for Benjamin by **Edward Chappell,** formerly merchandising manager of Benjamin's industrial lighting fixtures and chalkboard.

Harold A. Webster, president of the National Electrical Contractors Association, has been elected chairman of the 1961 National Electrical Week Observance. Mr. Webster, president of T. Frederick Jackson, Inc., a Long Island, N. Y. electrical contracting firm, has served as treasurer of the National Electrical Week

(*Continued on page 20A*)

SCHEDULED EVENTS

September 21-23, 1960—American Society of Mechanical Engineers—American Institute of Electrical Engineers, Power Conference, Bellevue-Stratford, Philadelphia, Pa.

September 26-30, 1960—Canadian Electrical Manufacturers Association, Sheraton-Brock Hotel, Niagara Falls, Ont.

October, 1960—American Society for Engineering Education, Annual Meeting of North-Midwest Section, Marquette University, Milwaukee, Wis.

October 5-7, 1960—International Association of Electrical Leagues, Annual Meeting, President Hotel, Kansas City, Mo.

October 9-14, 1960—American Institute of Electrical Engineers, Fall General Meeting. Chicago, Ill.

October 9-14, 1960—Electrochemical Society Meeting, Shamrock Hotel, Houston, Texas.

October 10-12, 1960—National Office Management Association, Fall Conference and Exposition, Atlanta Biltmore Hotel, Atlanta, Ga.

October 13-15, 1960—Optical Society of America Meeting, Somerset Hotel, Boston, Mass.

October 15-20, 1960—American Institute of Electrical Engineers, Fall General Meeting. Detroit, Mich.

October 16-18, 1960—United States National Committee, CIE, Annual Meeting, State College, Pa.

October 16-22, 1960—Society of Motion Picture and Television Engineers, Semi-Annual Convention, Sheraton Park Hotel, Washington, D. C.

October 19, 1960—Society of Plastics Engineers, Tooling for the Plastics Industry, New York, N. Y.

October 23-27, 1960—National Electrical Contractors Association, Las Vegas, Nevada.

October 25-27, 1960—American Standards Association, National Conference on Standards, Sheraton-Atlantic Hotel, New York, N. Y.

November 14-18, 1960—National Electrical Manufacturers Association (Annual Meeting), Traymore Hotel, Atlantic City, N. J.

November 17-19, 1960—Canadian Electrical Association, Engineering Sections, Western Zone, Saskatchewan Hotel, Regina, Sask.

November 21-23, 1960—Canadian Electrical Association, General and Sales Sections, Western Zone, Palliser Hotel, Calgary, Alta.

November 27-December 2, 1960—American Society of Mechanical Engineers, Annual Meeting, Statler-Hilton Hotel, New York, N. Y.

November 29, 1960—American Institute of Consulting Engineers, Annual Dinner, Waldorf-Astoria Hotel, New York, N. Y.

December 4-7, 1960—American Institute of Chemical Engineers, Annual Meeting, Statler Hotel, Washington, D. C.

December 5-9, 1960—National Conference on Application of Electrical Insulation, Conrad Hilton Hotel, Chicago, Ill.

January 23-26, 1961—Plant Maintenance and Engineering Show, International Amphitheatre, Chicago, Ill.

January 24-27, 1961—Society of Plastics Engineers, Inc., 17th Annual Technical Conference, Shoreham and Park Sheraton Hotels, Washington, D. C.

February 13-16, 1961—American Society of Heating, Refrigerating and Air Conditioning Engineers, Semi-Annual Meeting, Conrad Hilton Hotel, Chicago, Ill.

February 26-March 1, 1961—American Institute of Chemical Engineers, National Meeting, Roosevelt Hotel, New Orleans, La.

March 2-4, 1961—Optical Society of America, Roosevelt Hotel, Pittsburgh, Pa.

April 4-6, 1961—St. Louis Board of Trade, Progress in Electrical-Electronic Equipment Exhibit, Exposition Hall, St. Louis, Mo.

April 5-7, 1961—American Institute of Electrical Engineers, Southeast Meeting, New Orleans, La.

April 10-11, 1961—Society of Naval Architects and Marine Engineers, Spring Meeting, San Francisco, Calif.

April 10-14, 1961—American Society of Civil Engineers, Phoenix Convention, Hotel Westward Ho, Phoenix, Ariz.

April 19-21, 1961—American Institute of Electrical Engineers, Great Lakes District Meeting, Minneapolis, Minn.

April 20-21, 1961—Society of the Plastics Industry, Western Section Conference, del Coronado Hotel, Coronado, Calif.

April 30-May 4, 1961—Electrochemical Society Meeting, Claypool Hotel, Indianapolis, Ind.

May 8-11, 1961—Society of Photographic Scientists and Engineers, Annual Conference, Binghamton, N. Y.

I. E. S. National Technical Conferences

1961—September 24-29—Chase Park Plaza Hotel, St. Louis, Missouri

1962—September 9-14—Statler-Hilton Hotel, Dallas, Texas

1963—September 8-13—Sheraton-Cadillac Hotel, Detroit, Michigan

1964—August 30-September 3—Fontainbleau Hotel, Miami Beach, Florida

ELECTRICAL engineer S. K. Given (standing, photo at left), sales engineer Buck Clubley (far right, photo at left) and architect Donald H. Neptune (standing, photo at right) were among the members of a panel on "Specifying Lighting Equipment" at the Southern California Section's last meeting of the 1959-1960 IES year. Section VIP's at the head table are: (photo at left) vice-chairman, Edward Balogh; secretary-treasurer, J. Roy Jones; (photo at right) program chairman J. Samuel Hamel and section chairman, Benn Hartmann.

(Continued from page 19A)

Committee since its formation in 1956. He succeeds **N. J. MacDonald,** president of the Thomas & Betts Co., Inc., Elizabeth, N. J. and president of the National Electrical Manufacturers Association. Other officers for the Observance are: vice-chairman, **T. O. McQuiston,** Metropolitan Edison Co., Reading, Pa.; secretary, **Arthur W. Hooper,** National Association of Electrical Distributors, New York; treasurer, **L. W. O'Brien,** General Electric Co., New York.

Charles Wenner, president of the James R. Kearney Corp., St. Louis, and **John R. Morrill,** president of Hubbard and Co., Chicago, have jointly announced the consolidation of the Electric Engineers Equipment Division of Hubbard with the Kearney Corp.

George B. Earl has retired after 50 years of continuous service with the Utah Power & Light Co. At the time of his retirement, Mr. Earl was the business development manager of the company's Salt Lake Division. An IES member since 1947, he has recently been elected by the Board of Managers as an Honorary Life Member of the Utah Section.

Fred H. Dendy, Jr., president of Electrical Wholesalers, Inc., Atlanta, Ga., has announced the opening of the firm's new Buckhead branch, also in Atlanta. The new operation will be managed by **Don C. Martin,** assisted by **John Skinner,** warehouse manager. **Alex D. Erwin** heads up the lighting department for the entire company and **Maureen Lane** will serve as lighting consultant for the branch.

The Better Light Better Sight Bureau, New York City, has announced the election of **Coburn D. Hollister,** general sales manager of the Niagara Mohawk Power Corp., Syracuse, N. Y., as Bureau chairman and chairman of the executive committee. Mr. Hollister succeeds **W. G. McKie,** general sales manager of the Rochester Gas & Electric Corp. Also announced by the Bureau was the appointment of **Thomas H. Cashin** to the Executive Committee. Mr. Cashin, marketing manager for large lamp products of Sylvania Lighting Products, Salem, Mass., succeeds **Lawrence P. Pleasants.**

The Leadlight Fixture Co., Oakland, Calif., has become a division of the Wellmade Metal Products Co., according to an announcement by **Edward Bergen,** president of Wellmade. **Milton Kosman** has been named as sales manager of the new division.

IES Member **William W. Barr, Sr.,** D. Sc., received his Ph.D. from Burton College at ceremonies in Manitou Springs, Colo., on July 22. Mr. Barr, who is founder and president of Barr Electric Co., Inc., Arlot Electronics, Inc., and several research laboratories, all in Dallas, Texas, based his thesis on new developments in the field of self-energizing photoelectric cells and their uses in automatic switching controls.

Deaths

R. Blanco, Southeast Florida Section.
Bradford Jones, New England Section.
H. F. Quisenberry, Golden Gate Section.
Alva A. Togesen, Michigan Section.

BOOKS AND PAMPHLETS

Books marked * are available for inspection in the Technical Office at Society Headquarters.

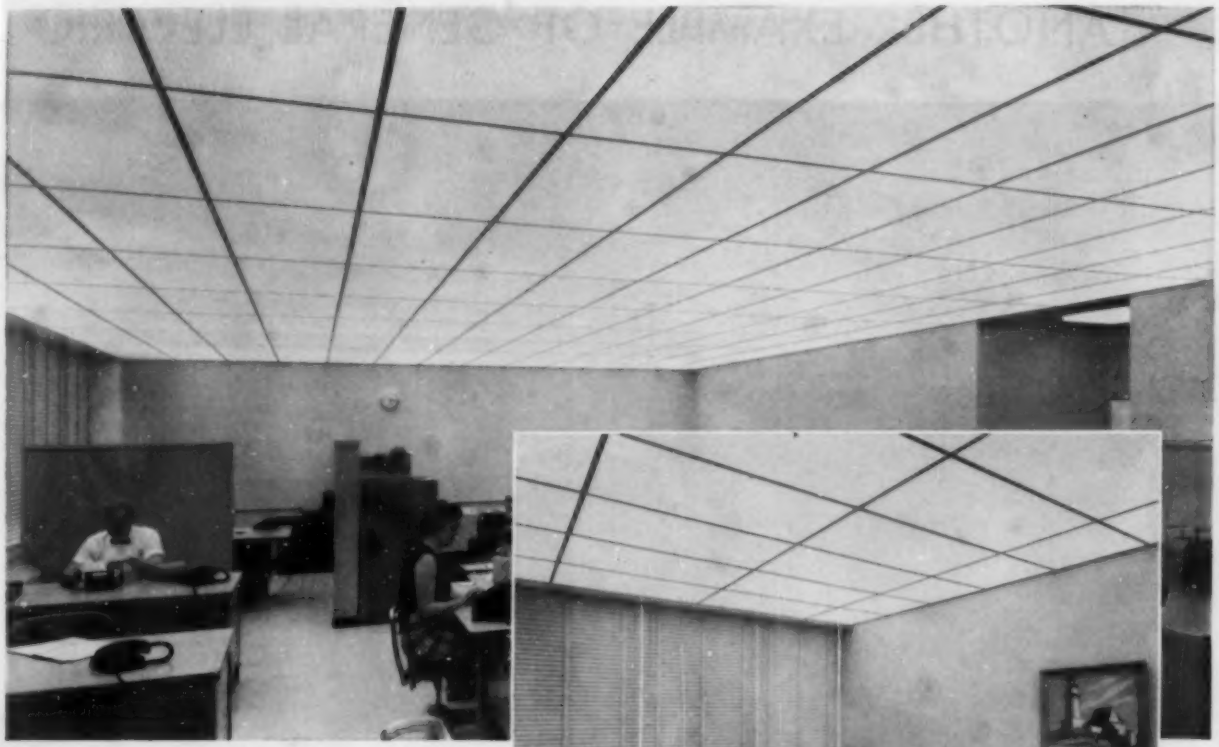
The Luminescence of Biological Systems,* edited by Frank H. Johnson, published by the American Association for the Advancement of Science, Washington, D. C., 1955, 420 pages, indexed. $7.00. ($6.00 to AAAS members.)

This book is a record of the proceedings of the Conference on Luminescences, March 28 to April 2, 1954, sponsored by the Committee on Photobiology of the National Academy of Sciences—National Research Council and supported by the National Science Foundation. There are 17 papers included dealing with many aspects of bioluminescence—light produced by plants and animals.

Underground Lighting in Mines, Shafts and Tunnels,* by A. Roberts, published by The MacMillan Co., 60 Fifth Ave., New York 11, N.Y., 1958, 292 pages, illustrated and indexed. $12.75.

The object of this British book is to explain current lighting terminology, to discuss the basic problems of lighting that are encountered in underground work and to suggest up-to-date lighting solutions. Chapter headings for the portion on lighting techniques are: Mine Roadway Lighting, Lighting the Working Face, Lighting in Explosive Atmospheres Un-

(Continued on page 54A)



200 Footcandles of Environmental Lighting with

SYLVANIA'S SYLVA-CELL SYSTEM

Sylvania's Sylva-Cell Lighting System often provides an installation with more than just superb lighting. Because of the versatility and attractiveness of this extended area lighting system, its use as a design element can contribute completeness and uniformity to the overall environment.

At West Penn Power Company's new Jefferson District Headquarters, Sylva-Cell gives soft, comfortable illumination to general areas, private offices and other individual rooms—with lighting levels of 200 foot candles or more.

At the same time it adds to the general effect by tying together and complementing the other design elements.

The flexible Sylva-Cell System—based on a 2′ x 4′ module—offers shieldings of plastic or aluminum louvers or Circlgrid, a new shielding with a refreshing, luminous circular pattern.

With its simplicity of installation and low-maintenance characteristics, Sylva-Cell can answer a wide variety of commercial and industrial lighting problems.

Look into the advantages of Sylva-Cell when your requirements call for high quality lighting plus a versatile design element to help create a comfortable, attractive atmosphere.

Complete details will gladly be sent on request.

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A Division of SYLVANIA ELECTRIC PRODUCTS INC.
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Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

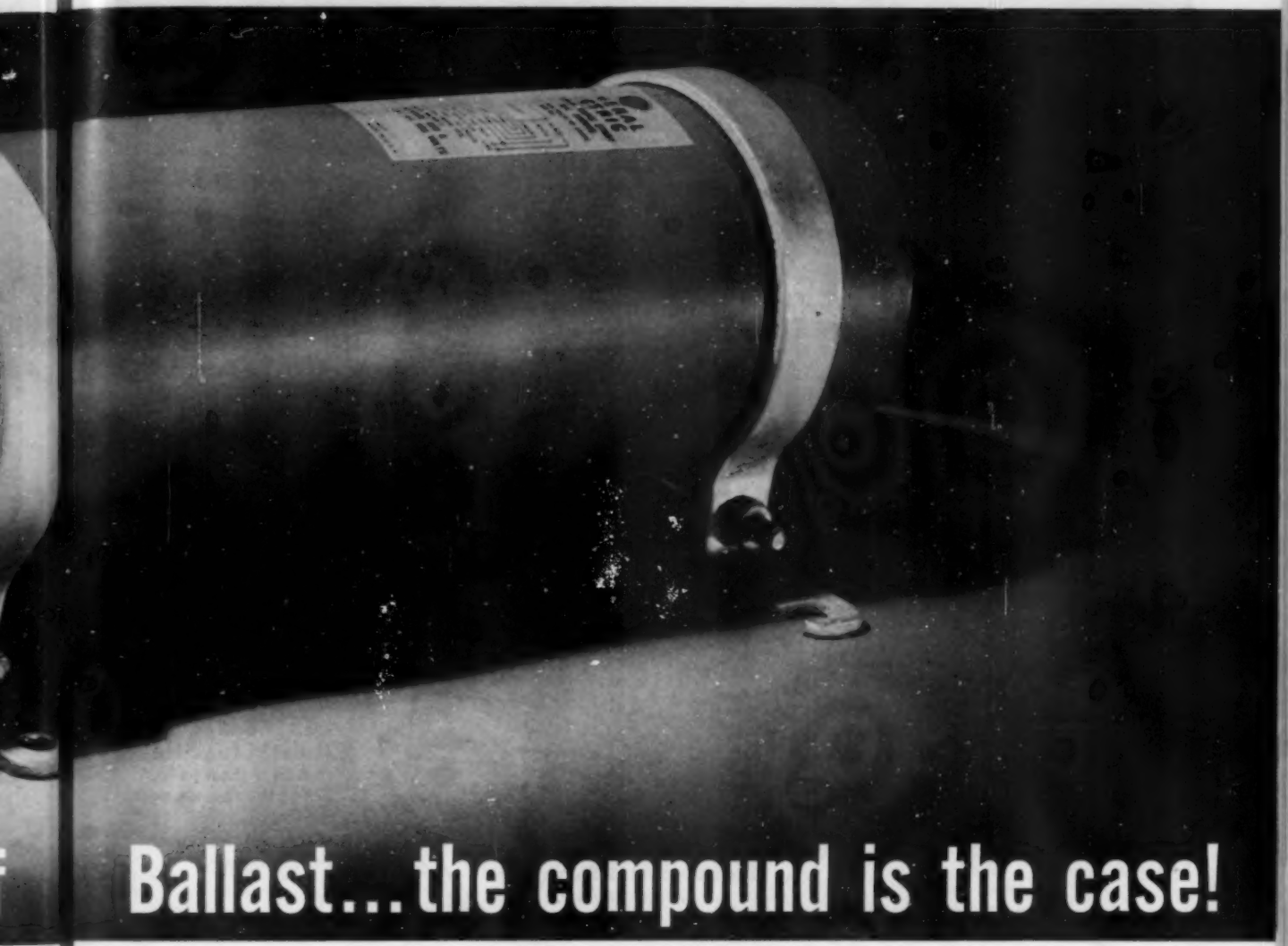
ANOTHER EXAMPLE OF GENERAL ELECTRIC

NEW General Electric Weatherproof

GORDON C. HARVEY, Manager of Engineering, General Electric Ballast Department, explains the significance of this important new fluorescent lamp ballast development.

"Take a good look at the NEW shape in ballast design above. You'll be seeing and hearing a lot about it during the next few months.

BALLAST ENGINEERING LEADERSHIP . . .



Ballast... the compound is the case!

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"Progress like this doesn't just happen. It is the result of experience gained since General Electric introduced the first fluorescent lamp ballast back in 1939. It is a product of diligent searching and testing in General Electric research laboratories, the most complete and widely respected in the industry. It comes from knowing what *you* want and being able to deliver when you need it."

Proved product excellence and engineering leadership are important reasons why you should always insist on General Electric ballasts for all your fluorescent lighting applications. For more information, write Section 401-72, General Electric Co., Danville, Illinois.

Progress Is Our Most Important Product

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*there's a difference**

*** That Difference is the Extra Features you can expect and depend on, when you buy or specify extrusions by ROTUBA**

1 Color. The New Azure-White. Visually pleasant and complimentary. Acclaimed by all who saw it at the National Lighting Exposition as a welcome color improvement for the Industry.

2 Extra Wall Thickness where it counts.

3 Destaticized on **BOTH** sides.

4 Uniform Wall Thickness for Even Light Transmission.

5 As much as 20% more usable light transmitted with superior obscuration.

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Do Your Present Extruded Shapes Have All These Important Extra Values?

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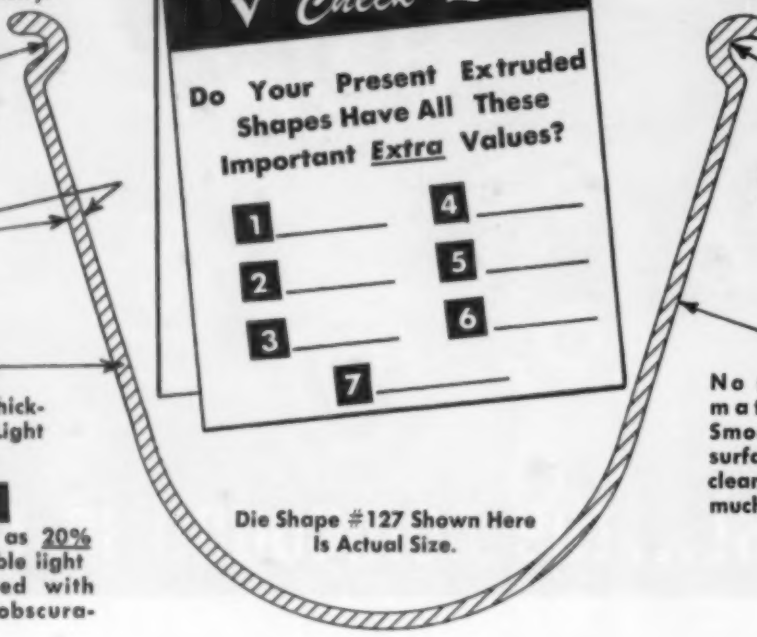

Die Shape #127 Shown Here Is Actual Size.

6 Radius for greater strength.

7 No ribbing. No matte finish. Smooth, lustrous surface is easier to clean, stays cleaner much longer.

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(Continued on page 26A)

((Continued from page 25A)

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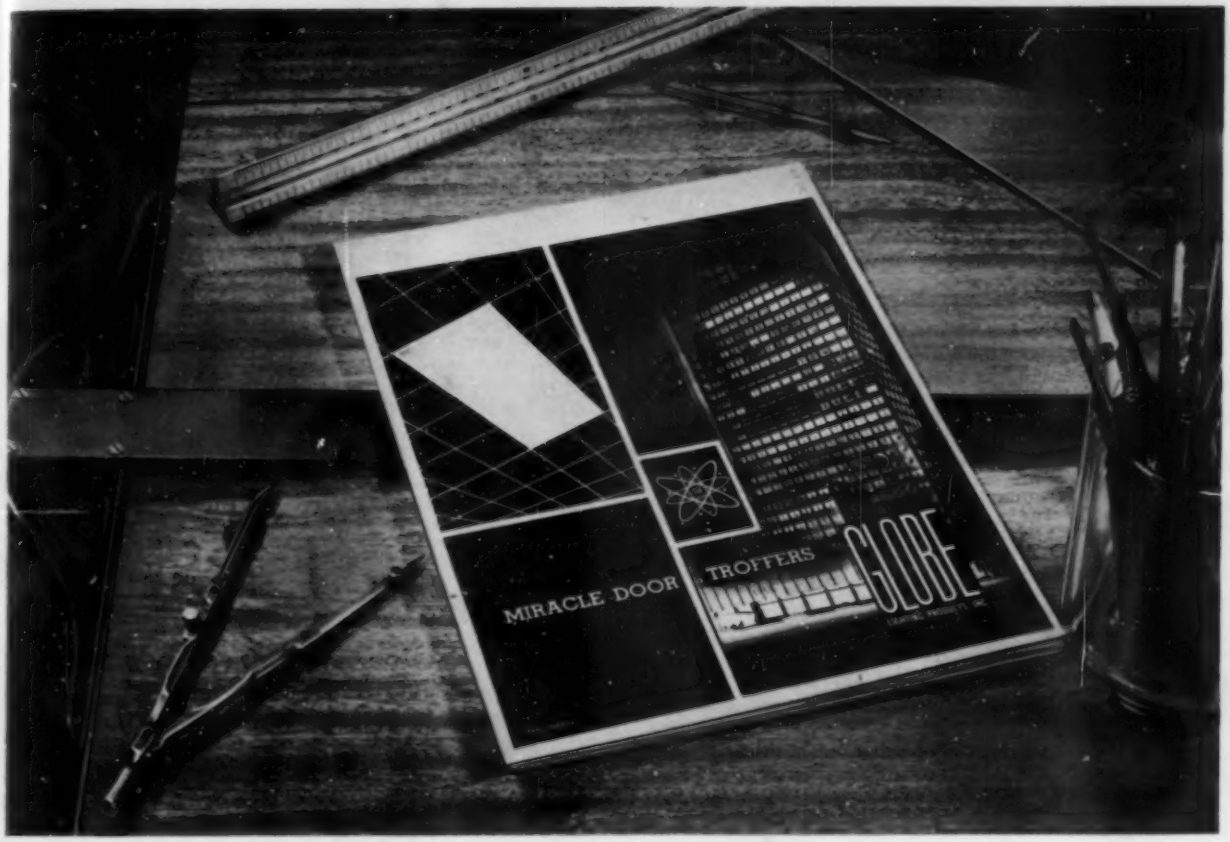

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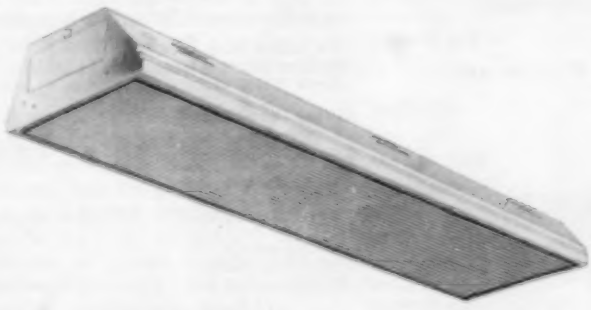
Send for your advance copy of the "Miracle Door Troffer Catalog."



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(Continued on page 32A)

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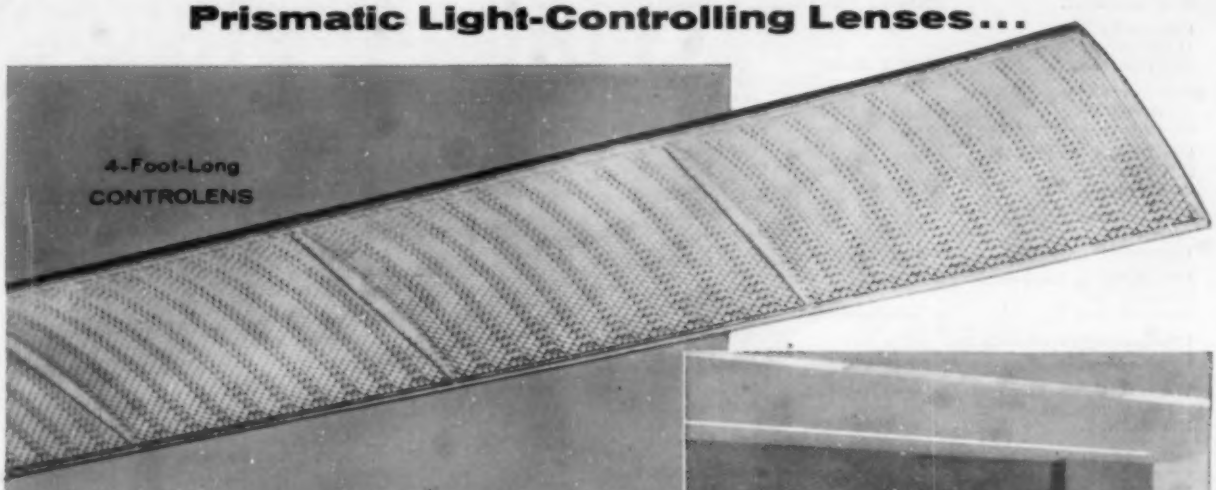

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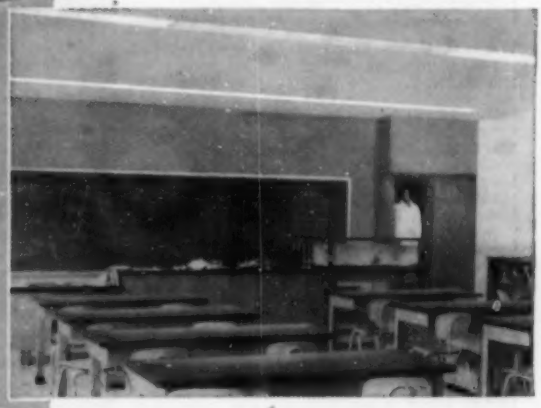

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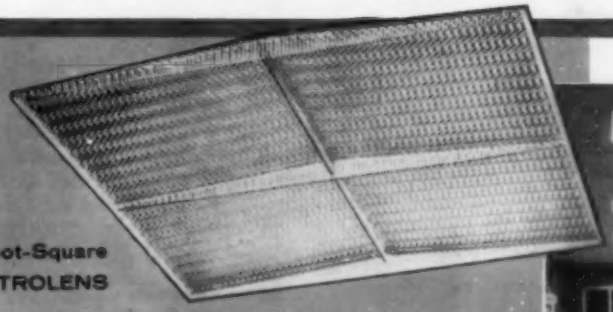

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(Continued on page 38A)

The latest lighting advancement from

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lighting unit to give you top operating performance from the amazing Quartzline lamp!

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Only the Appleton *Intenso "Quartzlite 500" is precision engineered to meet the lamp manufacturer's efficiency and operating standards for the new 500-watt, filament type, iodine cycle lamp.*

Its new, compact design was specially developed for this powerful lamp to give you 19% greater, *constant* light out put of 21 lumens per watt . . . and twice the average life of a conventional 500-watt lamp.

That's not all! Now, attractive lighting installations can be made compactly, easily, economically. The special weatherproof unit design also puts light where you want it. Its extremely sharp cutoff—in a rectangular beam spread—eliminates the usual need for beam overlap, yet provides adequate, uniform light for innumerable applications indoors and out.

For increased lighting efficiency in Industry • Commerce • Recreation • Transportation, buy or specify the versatile *Intenso* "Quartzlite 500" . . . ideal for signboards, displays, outdoor sports, building security, mobile equipment, storage areas and many other uses.

Contact your Appleton distributor or write today for complete details!

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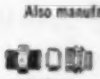
Explosion-Proof Lighting Fixtures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Automatic Reeltas

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Westinghouse...leadership in lamps
2½ TIMES MORE LIGHT AT THE WORK LEVEL
For high bay installations using standard fixtures, the Westinghouse Narrow Beam Incandescent Lamp with built-in reflector delivers 2½ times more foot candles at the work level than conventional broad beam reflector lamps. Cleaning is unnecessary since dust on bulb can't absorb light. In 500, 750 and 1,000 watt sizes.

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Westinghouse Lamp Division, Westinghouse Electric Corporation, Bloomfield, New Jersey

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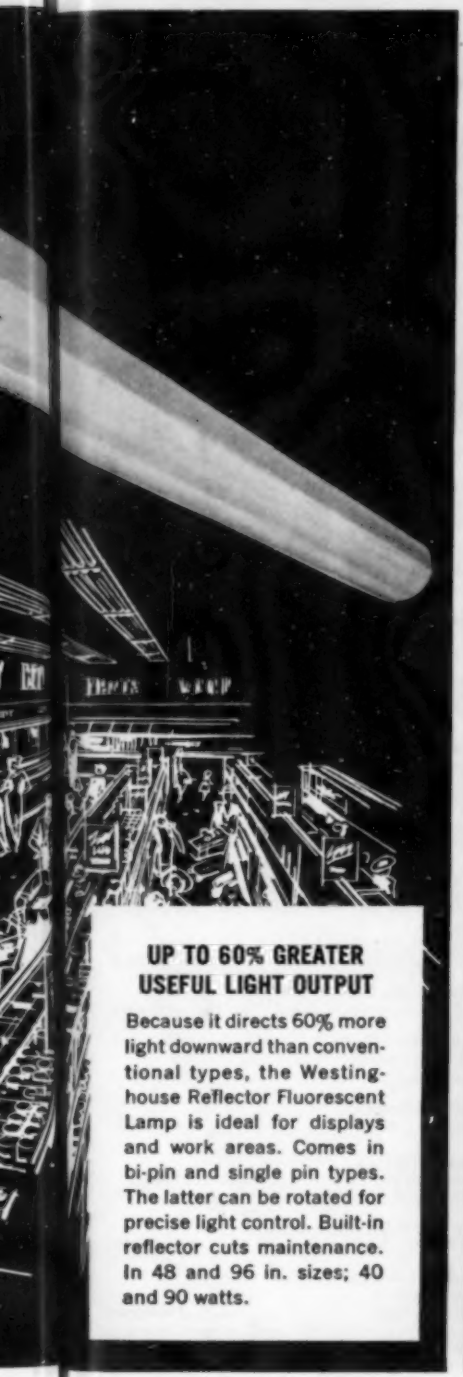

UP TO 60% GREATER USEFUL LIGHT OUTPUT

Because it directs 60% more light downward than conventional types, the Westinghouse Reflector Fluorescent Lamp is ideal for displays and work areas. Comes in bi-pin and single pin types. The latter can be rotated for precise light control. Built-in reflector cuts maintenance. In 48 and 96 in. sizes; 40 and 90 watts.

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Westinghouse

(Continued from page 34A)

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Div. of Pyle National Co.
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Newark 5, N. J. *Arthur Meister*

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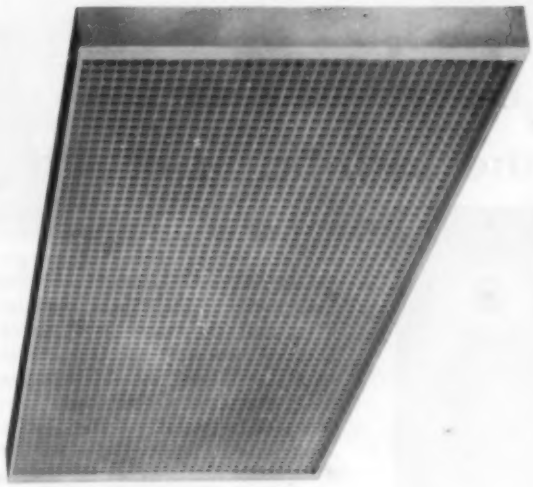
(Continued on page 60A)

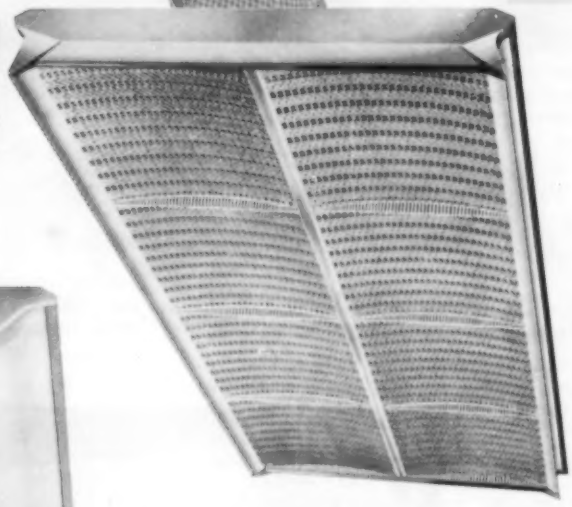
QPLM6500 for thin-lined architectural appeal.



QPCX7400 "Wrap-around" all-plastic enclosure.

QRH7500 (Sculpturama®) with all-curved styling.

QUICK CHANGE LIGHTING



QP8500 (Shallorama®) pioneer in shallow surface-mounted lighting.

Adaptability for future change is a basic design principle in back of Sunbeam Lighting fixtures. For instance, when you specify and install the ultra-shallow, surface-mounted Visionaires® #6500, #7400, #7500 or #8500 you are automatically planning ahead. The diffusers to these versatile series are all interchangeable. They give the building owner a wide choice of 16 different lighting possibilities when planning alterations. He might select QP8500 (Shallorama®) because of its recessed look and wide light distribution, QRH7500 (Sculpturama®) with the sculptured look and which is unexcelled in low brightness control or the QPCX7400 ("Wrap-around") with exclusive SUNLUX® plastic enclosure for soft diffusion. A quick change in lighting is as simple as the unique, tool-free, "hook-on" hinging arrangement can make it. Merely change the framed diffuser!

SUNBEAM visionaire

Investigate how Sunbeam Lighting today can save tomorrow!

SUNBEAM LIGHTING COMPANY

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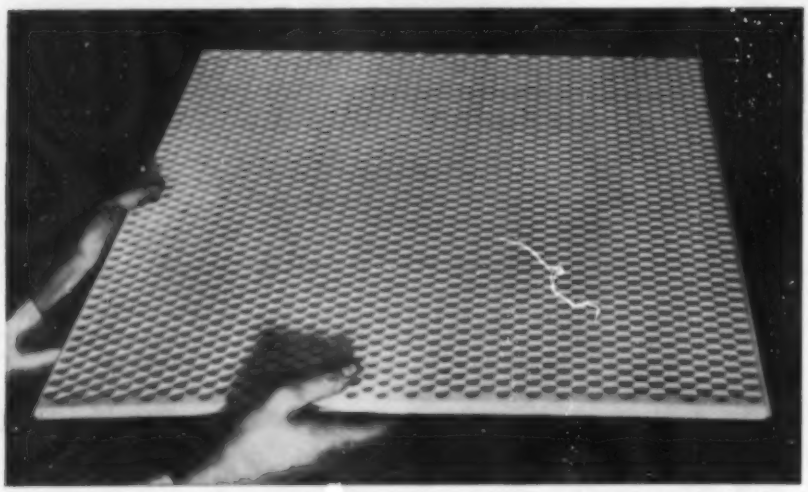
CIRCLGRID

Non-Combustible Vinyl Louver–A new luminous rigid panel for the Lighting Industry



A 2′ x 2′ Circlgrid Louver showing the pleasing proportion of the cells. Hundreds of circular cells in each panel provide controlled visual comfort and permit air circulation through the plenum.

Circlgrid Louvers are approved for use in all states including New York and California. These rigid lightweight vinyl louvers are attractive and highly efficient light diffusers. They are processed by Thermoforming two vinyl sheets and Electronically fusing them to a center vinyl membrane. This new vinyl material is specially formulated to maintain new highs in light stability. Unique circular cells permit installation under fire extinguishers, assist in sound absorption and permit plenum air circulation to prevent dust accumulation. CIRCLGRID-45 is available in nominal sizes of 2′ x 2′ and 2′ x 4′, with or without perforations, in various translucencies and with or without sealed-in metal perimeters.

CROSS SECTION THRU "CIRCLGRID" PANEL

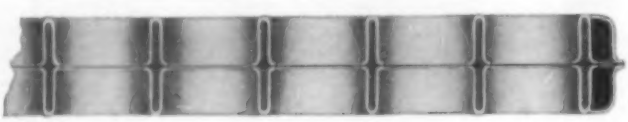
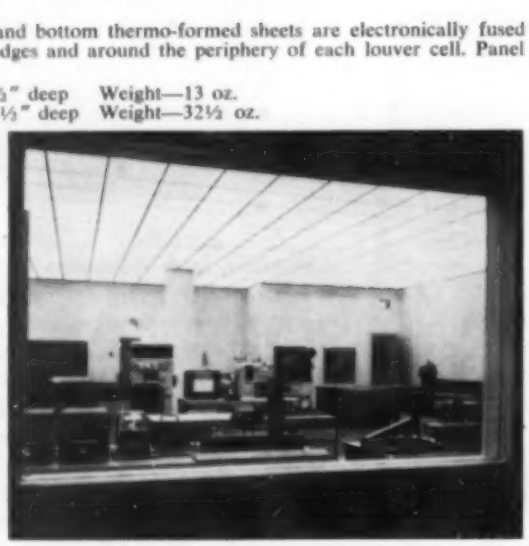


Diagram shows how the top and bottom thermo-formed sheets are electronically fused to a center membrane at all edges and around the periphery of each louver cell. Panel dimensions:

23¾″ square x ½″ deep Weight—13 oz.
23¾″ x 47¾″ x ½″ deep Weight—32½ oz.

CIRCLGRID Louvers play an important part in meeting the very stringent lighting specifications imposed for this G.E. Defense Plant because of the variety of instrument and optical type gauges in this room.



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cirvac plastics

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of the

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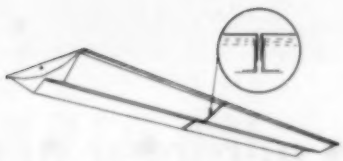

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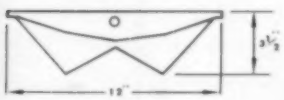
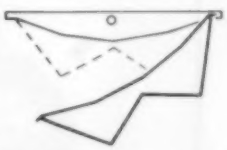


OVERALL SIZE SHOWS COMPACTNESS AND RECESSED APPEARANCE OF UNIT.



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LIGHT COMPANY *of St. Louis*

MODERN LIGHT COMPANY OF ST. LOUIS
7809 MAPLEWOOD INDUSTRIAL COURT
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Gentlemen:

☐ Please send sample of Fixture at user's price.
☐ Please send illustrated catalog page and design information.

Name _____
Address _____
Position _____
City _____ Zone ____ State _____

Wilkes Central High School, Wilkesboro, North Carolina

Not a glimmer of glare in this gym lighting job

INSTALLATION DATA

Abolite HMFAU-2400 fixtures with 750 watt incandescent lamps. Mounting height 22′ with 15′ 6″ x 16′ spacing. Ceiling height: 30′. Average footcandle level: 43.

Consulting Engineer:
George B. Rottman & Associates

Electrical Contractor:
Ralph Duncan Electric Company

Abolite uplight fixtures shield against glare, wash out ceiling shadows—There are 43 footcandles of light (average) throughout that gymnasium, yet there's practically no glare to bother spectators or players. This easy-on-the-eyes lighting is made possible by the unique design of Abolite fixtures. Notice how both vertical and horizontal surfaces are lighted evenly without any deep shadows and how the light directed upward through the open top of fixtures eliminates sharp contrasts by washing out dark background shadows. 35° lamp shielding virtually eliminates glare.

Abolite's modern air-swept design also reduces maintenance costs. Air circulating through the fixtures sweeps them clean of dulling dust.

Although in this installation Abolite fixtures are used with incandescent lamps, they can also be used with color-improved mercury lamps. There are 18″ and 24″ diameter Alzak aluminum fixtures for use with 400 and 1000 watt mercury and 14″ and 18″ diameter fixtures for 300-500 watt incandescent lamps. *Abolite Lighting Division, The Jones Metal Products Company, West Lafayette, Ohio.*

ABOLITE *Lighting*

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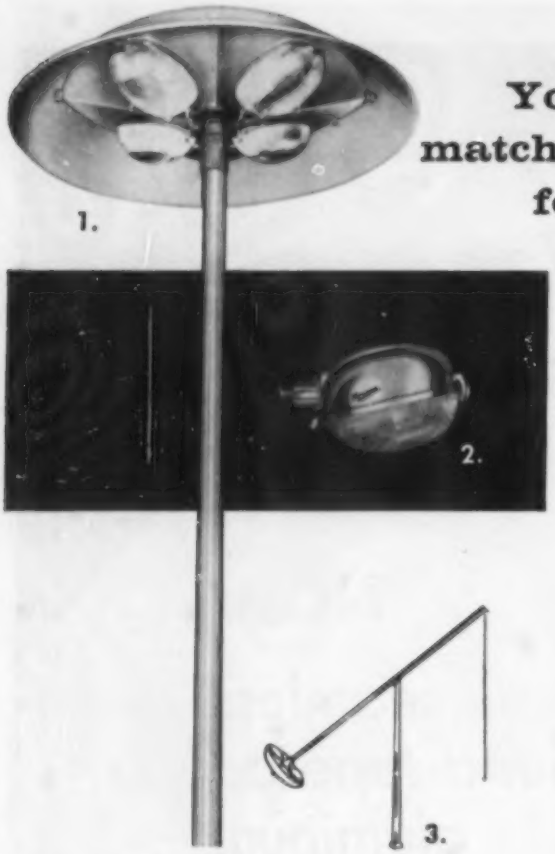

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1. **Revere Ultra-Lites** *are attractive and efficient for illuminating large areas brightly and uniformly. Each Ultra-Lite houses four 400-watt mercury lamps positioned to throw a square light pattern with wide coverage that cuts pole requirements 50 to 75%.*

2. **Endoval luminaires** *are used to light shopping-center parking lots, automobile sales lots, store fronts and similar applications where high intensity, glare-free light is desired. Uses 250 or 400-watt mercury lamps.*

3. **Revere hinged poles** *make for safe, economical lamp maintenance at ground level. Eliminates need for boom trucks or ladders.*

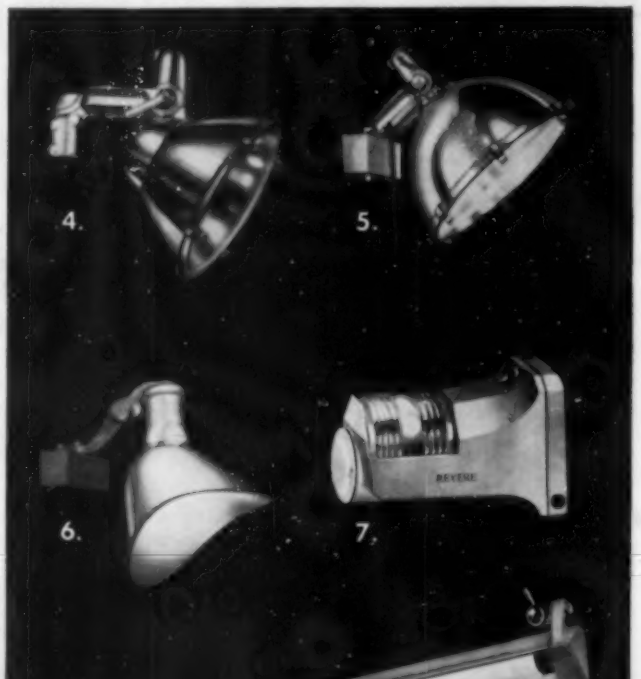
4. **4200 Series** *floodlights provide efficient large-area lighting for sporting fields, storage yards, buildings, etc., using 750, 1000, or 1500-watt incandescent lamps with wide or narrow-beam reflector.*

5. **7400 Series** *floodlights use 1000-watt mercury lamps to provide exceptionally high light output for railroad yards, sports fields, parking lots and other large-area applications.*

6. **3800 Series** *Eliptor floodlights are an economical source of high intensity lighting for smaller area, general-purpose applications. Eliptor floodlights are available for 300- to 1500-watt incandescent lamps.*

7. **3151 Series** *underneath floodlight provides unusually attractive lighting effects for buildings or other vertical surfaces.*

8. **Fluoresign** *outdoor luminaire is highly efficient, economical way to illuminate poster panels, store fronts, highway signs, painted walls and other surfaces, using HO, VHO, SHO or Power Groove lamps.*



ABOVE ALL:

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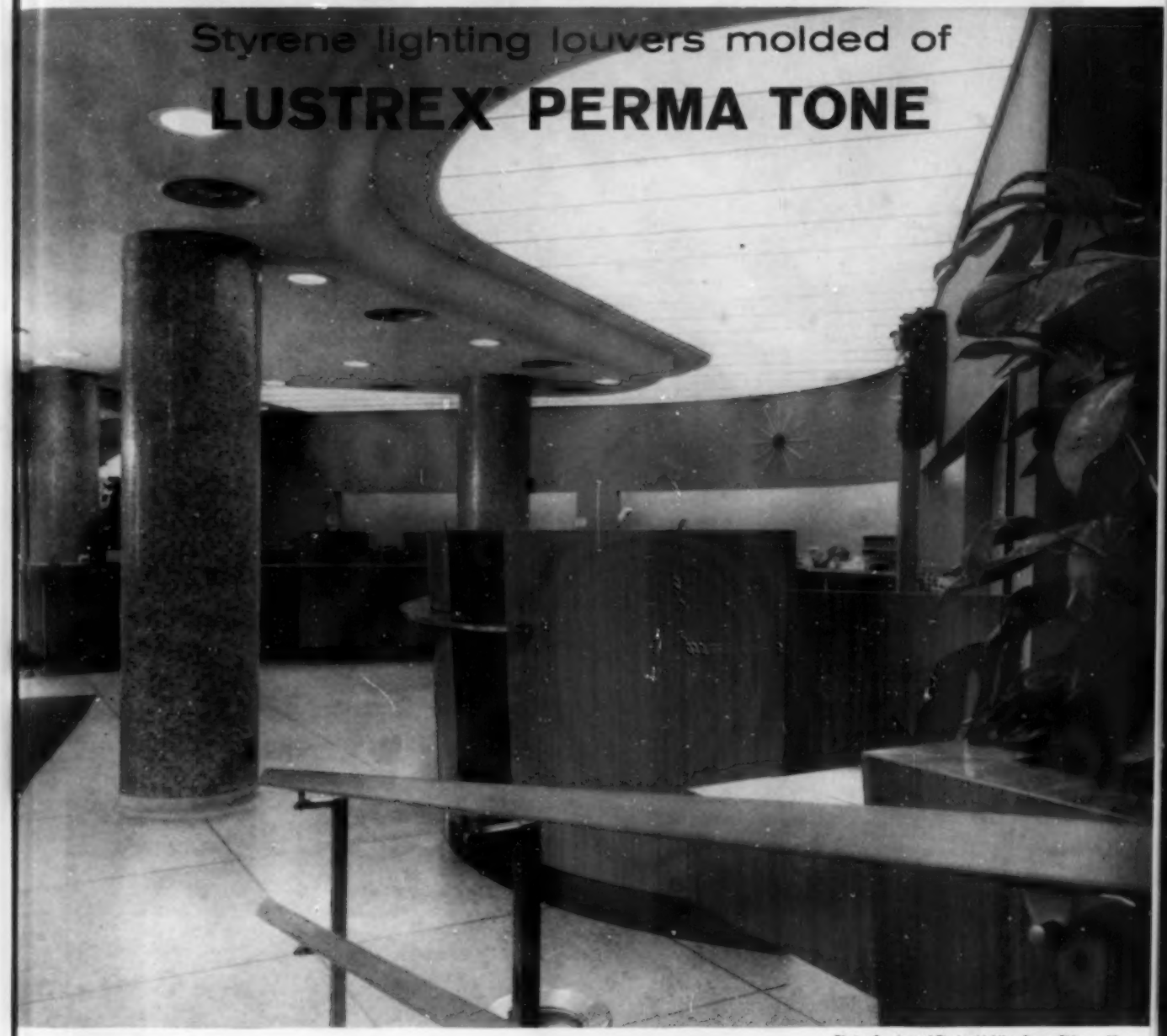
LUSTREX® PERMA TONE



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More Lustrex perma tone is used for lighting fixtures than any other ultraviolet light-stabilized styrene.

In clear white and a complete color range, it exceeds IES-NEMA-SPI joint specifications for ultraviolet light-stabilized styrene. With perma tone you can create low cost large areas of illumination with good diffusion, dimensional stability, and uniform light distribution.

New Impact Lustrex perma tone provides extra toughness and flexibility for snap-fitting to metal parts, high resistance to abnormal abuse, lighter weight through thinner walls. For free technical report on both regular and impact Lustrex perma tone styrene, including accelerated aging test results and other valuable data on styrene in lighting fixtures, write to Monsanto Chemical Company, Plastics Division, Room 782, Springfield 2, Massachusetts.

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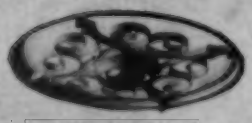
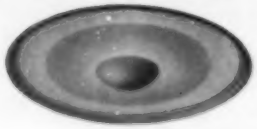
The Rambusch Dome is an efficient downlighting device with widespread light distribution and comfortable brightness contrast. Designed for ambient or general illumination, the dome can be recessed mounted, surface mounted, or pendant. It is adaptable for all types of ceiling construction, including hung pan and acoustical tile. Domes are available in four sizes from 19 to 43 inches in diameter and utilize standard lamps ranging in wattage from 150 to 500 Watts. Write for detailed data sheets DO-1 and DO-3 or see Sweet's Catalog—Lighting 33a/Ra

RAMBUSCH LIGHTING



METAL GRILLE



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Glass for lighting

A QUICK LOOK AT LIGHTING PROBLEMS ✓ SOLUTIONS ✓ USES ✓

GLASS TO FIGHT THE ELEMENTS

Glass for signaling is generally an outdoor proposition. Which means that it has to take all kinds of weather in all kinds of climates. This bobbing buoy bouncing outside a salt-water harbor is a good example. It's got to be there . . . got to be working. Reasons why it isn't won't do.

The assurance that pilots and sea captains will see this buoy comes from the fact that there's a PYREX brand globe over the light bulb. The globe protects it and the light stays on in hot weather and cold, in snow, sleet, rain, ice, salt spray and hurricanes.

A CASE OF COSTS

A manufacturer we know makes top-notch shot-blasting equipment for cleaning metal castings. Light bulbs are needed to see what's going on. The shot made too many bulbs go *poof*. There were two possible solutions, neither very practical. It boiled down to this: either work in the dark, or spend a small fortune to replace broken bulbs.

We came up with a different answer, a special heavy-wall glass globe, a half-inch thick, that covers the bulb to protect it. Now, there's plenty of light, and no shattered bulbs. Perhaps there's a place in your operation for glass that works . . . glass that saves you money.

A MATTER OF DESIGN

This round lens throws a *rectangular* beam, but it's intentional. An oil company needed several lights that would play rectangular beams on rectangular signs. The signs were 4- by 8-foot outdoor advertising displays, and they had to be lighted without hot spots that would make them tough to read.

Crouse-Hinds of Syracuse, N. Y., the firm handling the lighting, came to us with the problem. This lens does the job, yet it fits the standard shape lighting fixture. True, Crouse-Hinds could have built a special lighting fixture, but the cost would have naturally been higher. This light does what's needed and keeps costs at a sensible level.

While it's unusual, it's typical of the special lighting problems we tackle regularly.

A PROBLEM OF COMFORT

TV performers don't always have to go to the beach for their sun. They frequently get sunburned while on camera, but they don't recommend it as the best way to pick up a healthy tan. The intense heat generated by the big studio lights is mighty uncomfortable. Add to this the problem of telecasting from a room that just *can't* be air-conditioned during a hot summer night in Nashville, Tennessee. That's what faced the cast of "Grand Ole Opry" a few years back.

The suggestion was made that PYREX brand infrared reflecting glass could do wonders in reducing the heat. Sheets of this glass were bracketed to the front of the studio lights. They cut the heat output by 50%, yet retained 75% of the light output. The show did go on . . . comfortable, too. If you need a glass to keep light and cut heat, contact us. We'll be glad to help.

Lighting can pose problems, but glass faces up to them like no other material. If your problems are like these . . . or vastly different . . . let us know about them. Send the coupon below if you'd like more information on the role of glass in lighting.

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Please send me the following:

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SMOOT-HOLMAN Perfect Vision Luminaire

Granted U.S. Patents 2,932,728 and 2,933,279

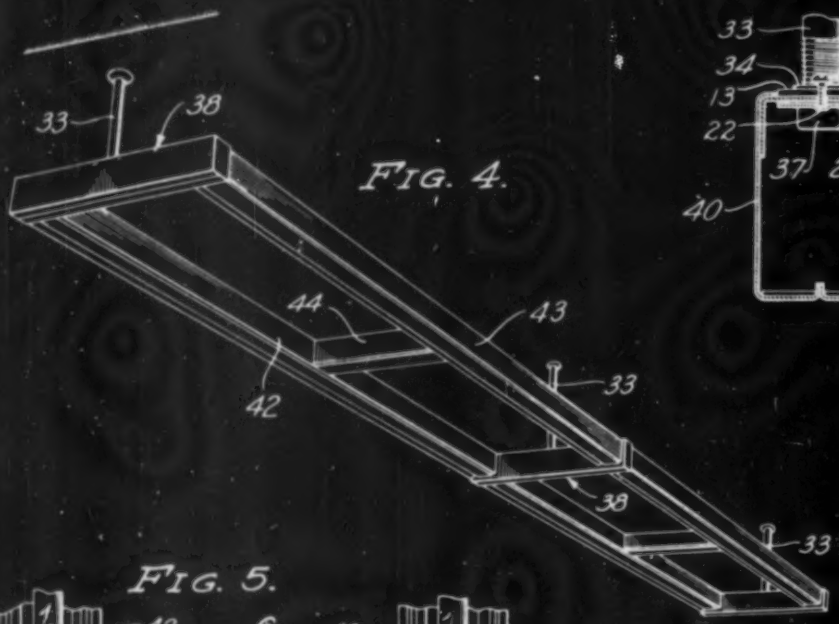


FIG. 4.

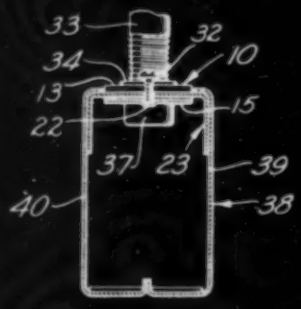
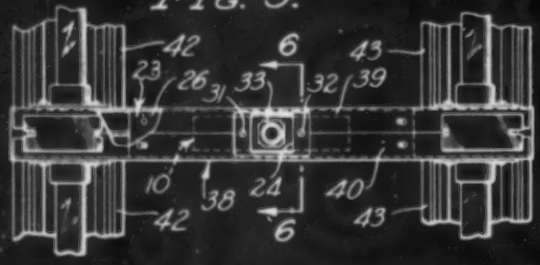


FIG. 6.

FIG. 5.



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The high performance Perfect Vision Luminaire is typical of Smoot-Holman originality in lighting fixture development. Smoot-Holman is the only lighting manufacturer using its own analogue computer to insure maximum efficiency in fixture design. For your next lighting job check Smoot-Holman first!

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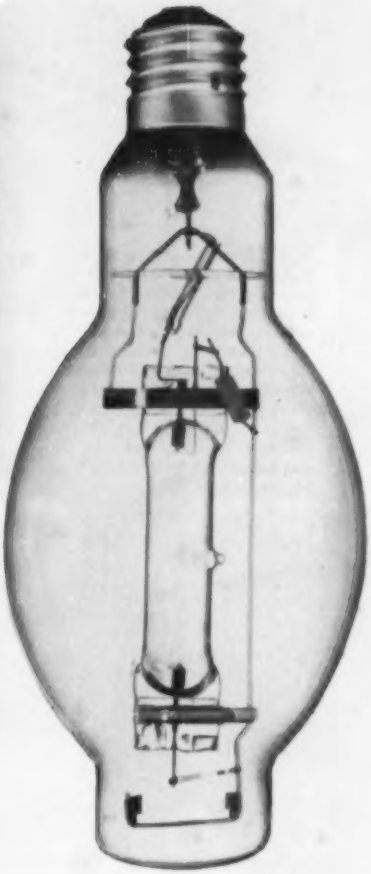
6000 USEFUL HOURS EXTRA



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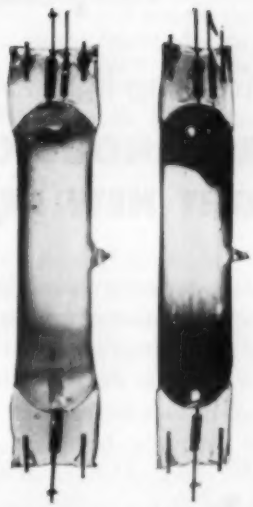

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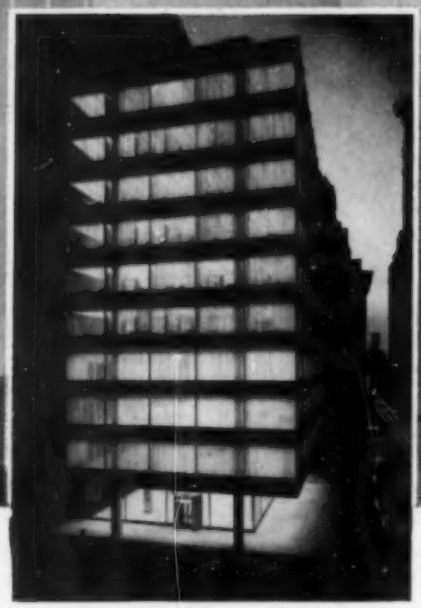
World Headquarters offices of Pepsi-Cola Company, 500 Park Avenue, New York City, are illuminated with ceiling panels of new impact resistant rigid vinyl sheet panels of modular design. Illumination level is 50 foot-candles at desk height. The BAKELITE vinyl panels were fabricated by Piolite Plastics Corp. Lighting was by Globe Lighting Products, Inc., and installation by Fischbach and Moore, Incorporated.



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IN MANY towering offices along New York's famous Park Avenue, translucent ceilings made of BAKELITE rigid vinyl sheet improve lighting efficiency and enhance decor. Here, in the World Headquarters of Pepsi-Cola, panels of new *high-impact* BAKELITE rigid vinyl sheet form a glowing, handsome ceiling. No shadows at eye level . . . no problem of balancing daylight and interior lighting. This is custom-made illumination—so natural, you are hardly aware of its existence!

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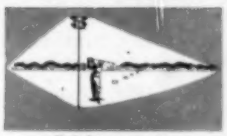
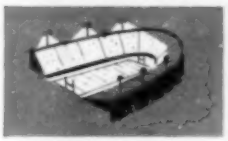
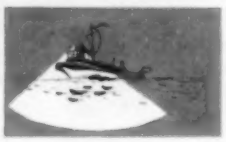


Driving ranges

Signs and billboards



Stadium lighting



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Imagine an intense beam of light with an 8° vertical spread and a 100° horizontal spread! A beam that maintains its intensity through the life of the light source . . . a beam that you can place *right* where you want it.

That's Lumitor — newest development by Wide-Lite to supplement the broad beam pattern of color-corrected mercury vapor Wide-Lites. Available in 500 and 1500-watt models, the Lumitor gives most effective use of the sensational new incandescent quartz-iodine lamps. Among its many advantages: filament life conservatively rated at 2,000 hours . . . a 50% increase in mean efficiency over other incandescent sources . . . and above all, a unique, well-defined light pattern that throws a "new light" on many floodlighting problems!

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CONNECTORS • CONDUIT FITTINGS • CIRCUIT CONTROLS

(Continued from page 20A)

derground, Mine Surface Lighting, and Tunnel and Subway Lighting.

The author, who is Director of the Post Graduate School of Mining, University of Sheffield, has addressed this book not so much to the lighting specialist as to those who claim no detailed knowledge of illuminating engineering, yet who find these types of lighting problems part of their professional responsibilities.

Facts About Plastics, available from the Cadillac Plastic & Chemical Co., 15111 Second Ave., Detroit 3, Mich. No charge.

Outstanding properties and typical industrial applications of 13 major plastic families in common industrial use are compared in this pocket-sized booklet. Some of those investigated are acrylic, nylon, high and medium impact styrene, polyethylene, and fibrous glass reinforced polyesters and epoxies.

IES Fellows

With the election of six new Fellows (see page 9A), the list of living IES Fellows, by Section and Chapter, including year of election, is as follows:

Alamo Section

Darley, William G. (1948), Consulting Engineer, 311 Tophill Rd., San Antonio, Texas.

Harmon, Darell B. (1947), Texas State Department of Health, Austin, Texas.

Buckeye Chapter

Franck, Kurt (1954), Holophane Company, Inc., Newark, Ohio.

Fry, Glenn A. (1953), Ohio State University, Columbus, Ohio.

Capital Section

Barrow, Louis E. (1955), National Bureau of Standards, Washington 25, D. C.

Breckenridge, Francis C. (1949), National Bureau of Standards, Washington 25, D. C.

Cleaver, Oscar Payne (1946), Engineer Research & Development Lab., Ft. Belvoir, Va.

Douglas, C. A. (1960), Photometry and Colorimetry Section, National Bureau of Standards, Washington, D. C.

Nickerson, Dorothy (1956), U. S. Dept. of Agriculture, Cotton Div., AMS, Washington 25, D. C.

Pearson, H. J. C. (1953), Duke Ave. Argyle Heights, Fredericksburg, Va.

Teele, Ray P. (1957), National Bureau of Standards, Washington 25, D. C.

Central New York Section

Cottrell, Casper L. (1955), Cornell University, Phillips Hall, Ithaca, N. Y.

Strong, Everett M. (1952), Cornell University, Phillips Hall, Ithaca, N. Y.

Chicago Section

Benson, Benjamin S., Jr. (1955), Benjamin Electric Mfg. Co., Des Plaines, Ill.

Church, Eric H. (1956), Lighting Products Inc., 1549 Park Ave. W., Highland Park, Ill.

Foulks, William V. C. (1952), Curtis-AllBrite Lighting Inc., 6135 W. 65th St., Chicago 38, Ill.

Hardacre, Gilbert K. (1956), Public Service Co., Div. of Commonwealth Edison Co., 51 W. Jackson St., Joliet, Ill.

Hjermstad, Hans U. (1958), Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.

Zersen, Carl W. (1953), Chicago Lighting Institute, 140 S. Dearborn St., Chicago 3, Ill.

Cleveland Section

Allen, Carl J. (1958), General Electric Co., Lamp Division, Nela Park, Cleveland, Ohio.

Barr, Arthur C. (1955), General Electric Co., Nela Park, Cleveland 12, Ohio.

Baumgartner, George R. (1953), General Electric Co., Nela Park, Cleveland, Ohio.

Brown, Willard C. (1945), 1450 Rydalmount Rd., Cleveland Heights 18, Ohio.

Cutler, C. M. (1952), General Electric Co., Nela Park, Cleveland 12, Ohio.

Dorsey, Robert T. (1959), General Electric Co., Nela Park, Cleveland, Ohio.

Downes, Arthur C. (1947), 2181 Niagarn Drive, Lakewood 7, Ohio.

Egeler, C. E. (1954), 1078 Brandon Road, Cleveland 12, Ohio.

Goodell, Paul H. (1947), Bettcher Mfg. Corp., West 61st at Clark Ave., Cleveland 2, Ohio.

Guth, Sylvester K. (1953), General Electric Co., Nela Park, Cleveland 12, Ohio.

Harrison, Ward (1945), 23475 Stanford Road, Cleveland 22, Ohio.

Horton, G. A. (1956), Westinghouse Electric Corp., 1216 W. 58th St., Cleveland 1, Ohio.

Kahler, William H. (1953), Westinghouse Electric Corp., 1216 W. 58th St., Cleveland 1, Ohio.

Linsday, E. A. (1959), General Electric Co., Nela Park, Cleveland 12, Ohio.

Lozier, W. Wallace (1957), National Carbon Research Labs., P.O. Box 6116, Cleveland 1, Ohio.

Meaker, Phelps O. (1960), Lamp Division, General Electric Co., Nela Park, Cleveland, Ohio.

NOEL, E. B. (1960), Lamp Division, General Electric Co., Nela Park, Cleveland, Ohio.

POTTER, WENTWORTH M. (1953), General Electric Co., Nela Park, Cleveland 12, Ohio.

PUTNAM, RUSSELL C. (1948), Case Institute of Technology, Cleveland 6, Ohio.

REID, KIRK M. (1948), General Electric Co., Nela Park, Cleveland 12, Ohio.

RODGERS, ALSTON (1957), General Electric Co., Nela Park, Cleveland 12, Ohio.

ROPER, VAL J. (1949), General Electric Co., Nela Park, Cleveland 12, Ohio.

STURROCK, WALTER (1946), 15002 Terrace Rd., E. Cleveland 12, Ohio.

THAYER, RICHARD N. (1958), General Electric Co., Nela Park, Cleveland, Ohio.

WAKEFIELD, GEORGE P. (1952), The Wakefield Co., Vermilion, Ohio.

WEBBER, MARY E. (1955), General Electric Co., Nela Park, Cleveland 12, Ohio.

WINKLER, FREDERIC C. (1947), Westinghouse Electric Corp., 1216 W. 58th St., Cleveland 1, Ohio.

CONNECTICUT SECTION

BEALS, GILLSON W. (1953), The Miller Co., Meriden, Conn.

NEIDHART, JOHN J. (1954), The Miller Co., Meriden, Conn.

DIABLO SECTION

FINCH, DAN M. (1954), University of California, Berkeley, Calif.

EASTERN NEW YORK

BOCK, JOHN E. (1952), 6 Irving Road, Scotia 2, N. Y.

FLORIDA SECTION

PRIDEAUX, GWILYM F. (1956), 528 15th Ave. S., Naples, Fla.

GOLDEN GATE SECTION

WALSH, JOHN S. (1958), Pacific Gas & Electric Co., 245 Market St., San Francisco, 6, Calif.

MARYLAND SECTION

SHARP, HOWARD M. (1945), Box 217, Easton, Md.

MICHIGAN SECTION

SCHRENK, L. J. (1952), City of Detroit, Public Lighting Commission, 174 Atwater St., Detroit 26, Mich.

WALL, HAROLD F. (1958), Public Lighting Commission, 174 E. Atwater St., Detroit 26, Mich.

MILWAUKEE SECTION

ILLING, I. L. (1947), 1754 Rocky Point Road, Pewaukee, Wis.

LAUPP, CHARLES N. (1956), Wisconsin Electric Power Co., 231 W. Michigan St., Milwaukee 1, Wis.

MOTHER LODE CHAPTER

GIBSON, CHARLES D. (1955), Bureau of School Planning, California State Dept. of Education, 721 Capitol Ave., Sacramento 14, Calif.

NEW ENGLAND SECTION

ALLPHIN, WILLARD (1950), Sylvania Electric Products, Inc., 60 Boston St., Salem, Mass.

BROWN, RICHARD B., JR. (1945), Boston Edison Co., 39 Boylston St., Boston, Mass.

HALVORSON, C. A. B. (1955), 25 Chestnut St., Salem, Mass.

JEROME, CHARLES W. (1957), Sylvania Electric Products, Inc., 60 Boston St., Salem, Mass.

LOWELL, WILLIAM P., JR. (1953), Sylvania Electric Products, Inc., 60 Boston St., Salem, Mass.

PARKER, ALLAN E. (1946), Worcester Polytechnic Institute, Worcester 2, Mass.

RADDIN, ELLERY H. (1952), Champion Lamp Works, 600 Broad St., Lynn, Mass.

NEW JERSEY SECTION

BEGGS, EUGENE W. (1952), 43 Hamilton Road, Glen Ridge, N. J.

BRUUN, SVEND W. (1958), Consulting Engineer, 420 Lexington Ave., New York 17, N. Y.

COX, JAMES L. (1958), Duro-Test Corp., 2401 Hudson Blvd., N. Bergen, N. J.

FREEMAN, GEORGE A. (1957), Westinghouse Electric Corp., Bloomfield, N. J.

HIBBEN, SAMUEL G. (1945), 31 Clinton Ave., Montclair, N. J.

JENSEN, BRUCE J. (1956), Public Service Electric & Gas Co., 80 Park Place, Newark, N. J.

WATERMAN, MARSHALL N. (1956), Westinghouse Electric Corp., Bloomfield, N. J.

ZABEL, ROLLAND M. (1951), Westinghouse Electric Corp., Bloomfield, N. J.

ZAHOUR, ROBERT L. (1958), Westinghouse Electric Corp., Bloomfield, N. J.

NEW YORK SECTION

BERENS, CONRAD, (1946), Ophthalmologist, 111 E. 59th St., New York 22, N. Y.

BUTTOLPH, L. J. (1952), 1 Columbia Ave., Cliffside Park, N. J.

COOPER, BERLON C. (1959), McGraw-Hill Publishing Co., 330 W. 42nd St., New York, N. Y.

CROUCH, CAZAMER L. (1946), Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

FAHSBENDER, MYRTLE (1954), Westinghouse Electric Corp., Bloomfield, N. J.

FERREE, GERTRUDE RAND (1952), Box 422, Stony Brook, L. I.

LOGAN, HENRY L. (1947), Holophane Co. Inc., 342 Madison Ave., New York 17, N. Y.

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McCandless, Stanley (1959), Century Lighting, Inc., 521 W. 43rd St., New York, N. Y.

Presbrey, Priscilla (1959), Westinghouse Electric Corp., Bloomfield, N. J.

Rambusch, Edward V. A. (1952), Rambusch Decorating Co., 40 W. 13th St., New York, N. Y.

Salter, Ernest H. (1953), Electrical Testing Laboratories Inc., 2 East End Ave., New York 21, N. Y.

Williams, Rollo Gillespie (1960), Century Lighting Inc., 521 W. 43rd St., New York, N. Y.

Non-Section

Waldram, J. M. (1952), Research Laboratories of General Electric Co., Ltd., Wembley, England.

North Texas Section

Folsom, William E. (1952), Dallas Power & Light Co., 1506 Commerce St., Dallas 1, Texas.

Oetting, Robert L. (1954), General Electric Co., 6500 Cedar Springs Road, Dallas, Texas.

Palmetto Section

Rex, C. H. (1954), General Electric Co., Outdoor Lighting Department, Hendersonville, N. C.

Philadelphia Section

Brainerd, Arthur A. (1946), Star Route, Erwinna, Pa.

Hallman, Eric B. (1953), Electric Service Mfg. Co., 17th & Cambria Sts., Philadelphia 32, Pa.

Holmes, P. R. (1946), General Electric Co., 3 Penn Center Plaza, Philadelphia, Pa.

Shoemaker, George E. (1953), 20 Matlack Lane, Villa Nova P. O., Pa.

Pittsburgh Section

Clark, George W. (1959), Sylvania Electric Products Inc., One 48th St., Wheeling, W. Va.

Rowten, Dana W. (1957), Sylvania Electric Products Inc., One 48th St., Wheeling, W. Va.

Slauer, Richard G. (1949), Sylvania Electric Products Inc., One 48th St., Wheeling, W. Va.

Puget Sound Section

Bakeman, C. T. (1947), 4234 92 N.E., Bellevue, Wash.

Rochester Section

Evans, Ralph M. (1953), Eastman Kodak Co., 65 Kodak Park, Rochester 4, N. Y.

Rocky Mountain Section

Buck, G. B. (1960), Lamp Division, General Electric Co., Denver, Colo.

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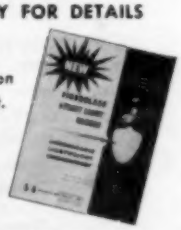

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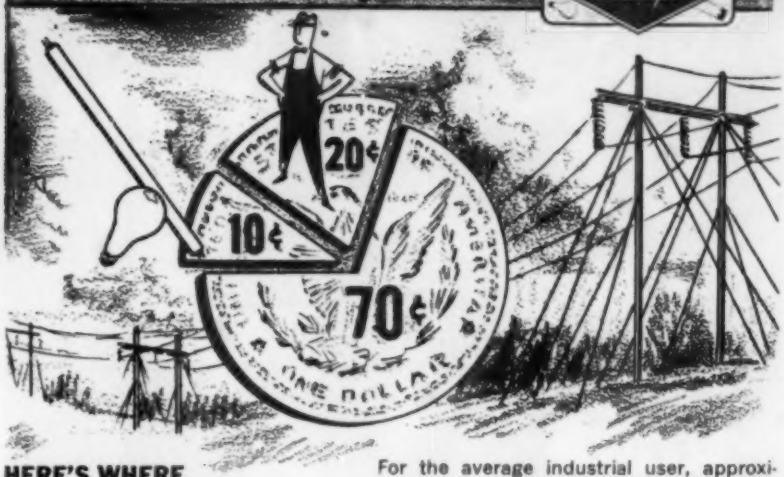

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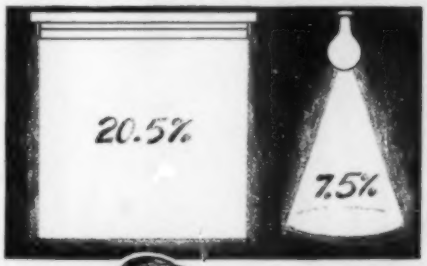

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GOTHAM

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McCULLOCH, JAMES H. (1957), Independent Testing Laboratories, 1928 14th St., Boulder, Colo.

ST. LOUIS SECTION

AMICK, CHARLES L. (1955), Day-Brite Lighting, Inc., P. O. Box 141, St. Louis 66, Mo.

BRADLEY, RICHARD D. (1959), Day-Brite Lighting, Inc., P.O. Box 141, St. Louis 66, Mo.

LEWIS, CARTER (1955), Union Electric Co., 315 N. 12th St., St. Louis 1, Mo.

TAYLOR, GEORGE J. (1953), Day-Brite Lighting, Inc., 212 South Central Ave., Clayton 5, Mo.

SAN JOSE CHAPTER

BROWN, LELAND H. (1945), Illumination Laboratory, Stanford, Calif.

SOUTHERN CALIFORNIA SECTION

BOELTER, LLEWELLYN M. K. (1948), University of California, Dept. of Engineering, Los Angeles 24, Calif.

HAMEL, J. SAMUEL (1957), 1122 Rossmoyne St., Glendale 7, Calif.

JONES, J. ROY (1957), Westinghouse Electric Corp., 600 St. Paul Ave., Los Angeles, Calif.

O'BRIEN, PHILIP F. (1960), University of California, Los Angeles, Calif.

SHEPHERD, THEODORE H. (1957), Dept. of Water & Power, P.O. Box 3669, Terminal Annex, Los Angeles 54, Calif.

SOUTHERN COLORADO SECTION

KRAEHENBUEHL, JOHN OTTO (1948), 10 Scott St., Broadmoor Park, Colorado Springs, Colo.

TAR HEEL SECTION

PALMER, ROY A. (1954), Duke Power Co., Power Bldg., Charlotte, N. C.

TORONTO SECTION

BATEMAN, JOSEPH W. (1953), Canadian General Electric Co., Ltd., 165 Dufferin St., Toronto, Ont.

CHORLTON, JOHN M. (1958), Toronto Board of Education, 155 College St., Toronto 2B, Ont.

DAVIDSON, HEDLEY F. (1958), Curtis-AllBrite Lighting, Ltd., 195 Wicksteed Ave., Toronto, Ont.

DEAN, GEORGE FRANKLIN (1956), Toronto Hydro Electric System, 14 Carlton St., Toronto, Ont.

LOVE, ROBERT M. (1946), Canadian General Electric Co., Ltd., 940 Lansdowne Ave., Toronto, Ont.

MUDGETT, GUERNSEY F. (1946), Canadian Westinghouse Supply Co., Ltd., 2 Carlton St., Toronto, Ont.

TWIN CITY SECTION

JOHNSON, LAWRENCE E. (1959), Northern States Power Co., 15 S. 5th St., Minneapolis 2, Minn.

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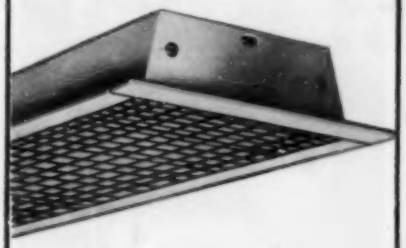

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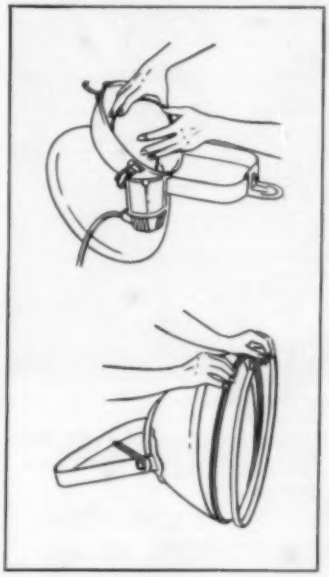

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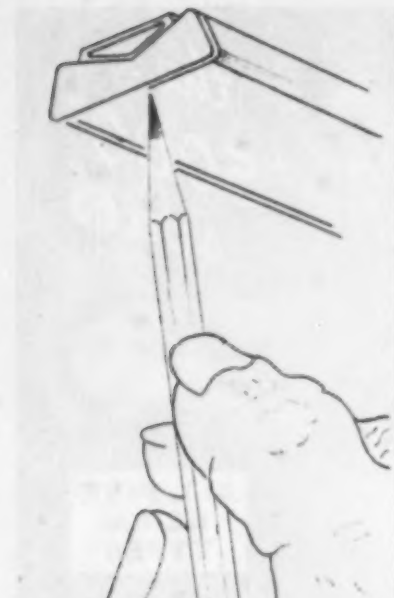

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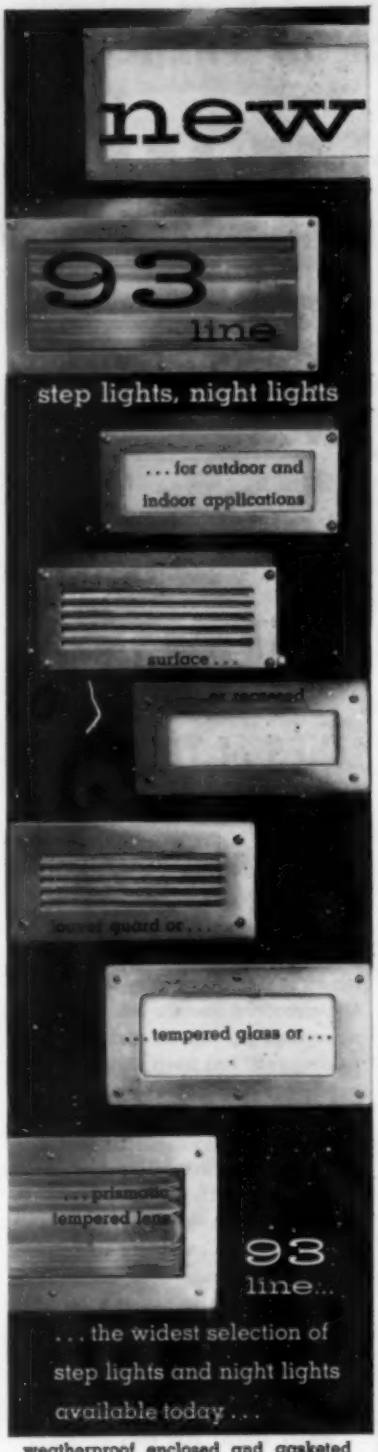

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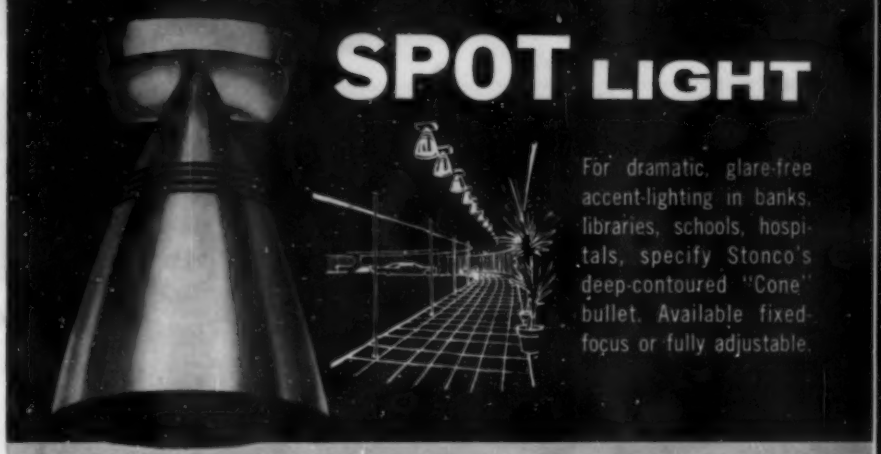

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Available Now!

INNER REFLECTOR *plus*

PHOSPHOR COATING

and

HARD GLASS

- **R80** *1000W & 700W*
- **R60** *400W & 250W*

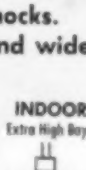
RADIANT Merco-White High Beam features

- ★ Protected inner reflector; highest reflection factor.
- ★ Phosphor coating provides good color improvement.
- ★ Highest percentage of *delivered* lumens to work area.
- ★ Higher initial and maintained illumination.
- ★ Eliminates expensive, heavy fixtures. Reduces installation costs.
- ★ Hard glass (Pyrex) withstands thermal shocks.
- ★ Combines two light patterns, narrow and wide, for complete coverage.

★
National distribution
Lighting layout service
Favorable discounts

Contract Prices Without a Contract

INDOOR
Extra High Bays



Can use porcelain socket by itself in most locations.

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Installation

Can use lightweight, inexpensive lamp holder.

Send for Bulletin 89

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Industrial Lamp Specialists Since 1938

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Originators of Reflector Type Hard Glass R40, R60 & R80 Incandescent Lamps

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New York City. Quality Manufacturer Architectural Lighting Equipment. Salary. Address Box 451, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

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Lighting sales engineer, capable of pricing, layout and selling, to manage Commercial Lighting Dept. Connecticut. Pay commensurate with ability. Write resume to Box 452, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

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Specalist in street and floodlighting with over 26 years' experience in production, engineering and sales. Sales Manager for past three years. Seeking similar connection in the New York—Philadelphia area. Address Box 453, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

POSITIONS OPEN

The fastest growing manufacturer of quality fluorescent lighting fixtures on the East Coast has a number of prime openings for qualified sales personnel. Men with experience in contacting Contractors, Engineers and Architects have a unique opportunity for a high paying position where the Sky is the Limit. Unusual opportunities for the right men in New York, New Jersey and Pennsylvania. All replies in strictest confidence. Address Box 461, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Specification Lighting Lines Wanted

Successful Philadelphia-based sales group now represents prominent manufacturer of interior fluorescent fixtures, commercial and industrial only. Sales opportunities are daily encountered for non-conflicting lighting lines, including commercial and industrial incandescent, as well as outdoor, stage and church requirements.

Now forming a hard-hitting, well financed sales agency of experienced sales personnel. Delaware Valley, Eastern Pennsylvania, Southern New Jersey and Delaware are being thoroughly and aggressively covered and sold through franchised electrical distributors.

Have excellent following of contractors, architects and engineers and plan to sell an entire lighting package of top quality lines. Companies must be financially well established, offering proper service and policies to back up a substantial volume.

Replies held in strict confidence. Send catalog and pertinent information to Box 455, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

NEW! OBSTRUCTION LIGHTS

HIGH QUALITY — LIGHT WEIGHT
SIMPLE — POSITIVE LATCH
FOR EASIER MAINTENANCE

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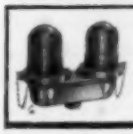
MODEL OB21 is of the SIDE ENTRANCE conduit fitting type in order to facilitate installation on horizontal conduit runs. Available in ¾" or 1" conduit tap

MODEL OB20 is of the BOTTOM ENTRANCE conduit fitting type to facilitate installation on vertical conduit stubs. Available in ¾" or 1" conduit tap



MODEL OB22 DOUBLE LIGHT is available with or without CABLE SUPPORT — also available with TRANSFER RELAY. 1" conduit tap

Request Descriptive Bulletin HPS-138

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We manufacture a complete line of fluorescent and incandescent lighting equipment distributed nationally through authorized electrical distributors, for the commercial, institutional, and industrial markets.
The specification type market is stressed due to our modern and complete, self-contained production facilities and experience in providing lighting equipment which will meet the strictest Architectural or Engineering requirement . . . from the complex, custom-designed in small quantities, to the large quantity competitively-priced unit.
Since our recent merger with a large electronics firm, it has been decided by Management to expand our national distribution in certain marketing areas in line with our expanded and accelerated production capability. Knowledge and experience in Sales-Engineering type contact with Architects, Engineers, Contractors, and Distributors is a prime requisite. Territorial coverage is being expanded on a national scale with many prime areas available. Please submit complete facts in first letter which will be held in strictest confidence. Address Box 456, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

POSITION WANTED

Free lance; fixture design and layout, shop drawings, catalogue work. Address Box 457, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

FIXTURE DESIGNER WANTED

Experienced designer capable of handling complete design of fluorescent and incandescent fixtures wanted by New Jersey manufacturer. Excellent opportunity for person with creative ability. In replying, include resume and salary requirements. Address Box 458, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

WANTED MANUFACTURERS' REPRESENTATIVES

Established West Coast fixture manufacturer desires representation in Mid-Western and Southern States. We are looking for representatives operating on an engineer-architect level. Complete line of semi-specialized lighting elements for hospitals, churches, highways, schools, security institutions. Write giving resume, territory, and current lines. Address Box 459, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

WANTED

Graduate Electrical Engineer to supervise Fluorescent Lamp Test Department with long established lamp manufacturer. Must have good background on instrumentation. Submit complete resume with application. Address Box 460, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

WANTED
LIGHTING REPRESENTATIVE

Long-established top name manufacturer of specification line Commercial and Industrial lighting fixtures—extensive incandescent and fluorescent line—has opening in Champaign-Decatur, Illinois area. Address Box 454, Publications Office, Illuminating Engineering Society 1860 Broadway, New York 23, N. Y.

SALESMAN

Acquainted with architects or electrical contractors wanted by manufacturer of top line commercial fluorescent and incandescent fixtures for New Jersey. High earnings, substantial weekly drawing plus expenses to right man. AMERICAN LIGHTING CORPORATION, 164 South St., Hackensack, N. J.

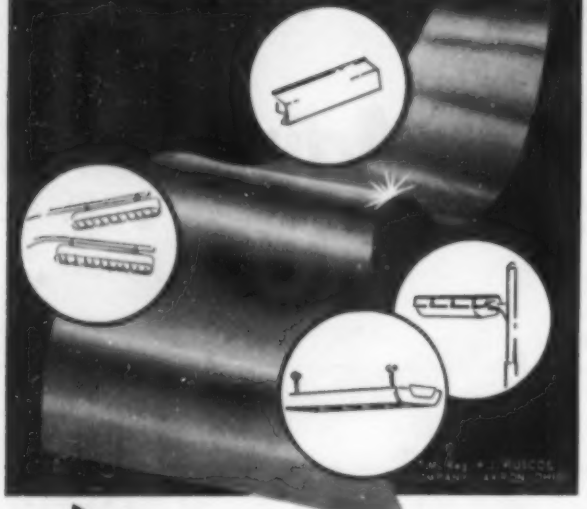
LIGHTING REPRESENTATIVES WANTED

REDESIGNED SPECIFICATION GRADE COMMERCIAL fluorescent and incandescent lighting fixtures. Both standard and custom designed for Dept. Stores, Offices, Institutions, etc. Many territories open. Replies held in strict confidence. Kent Lighting Corp., 500 Johnson Ave., Brooklyn 37, N. Y.

TO REDUCE LUMINAIRE MAINTENANCE

SPECIFY

DYNASYL



DYNASYL Specular Aluminum Reflector Sheet (Pat. Applied For) is corrosion resistant, stays bright even in areas with heavy salt concentration. Ideal in industrial areas, DYNASYL retains original reflectivity with an occasional wipe of a damp cloth.

DYNASYL is outstanding for use in lighting equipment design and manufacturing. It can be punched, crimped or drilled without damage to the finish. Ready for use without buffing or anodizing, DYNASYL helps keep costs low. Available in any gauge, temper or alloy.

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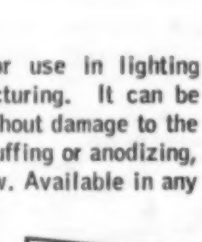

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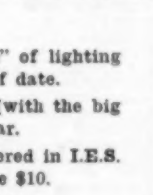
GIMBAL RING for R30, R40 and PAR 38 screw-base lamps.



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Third Edition

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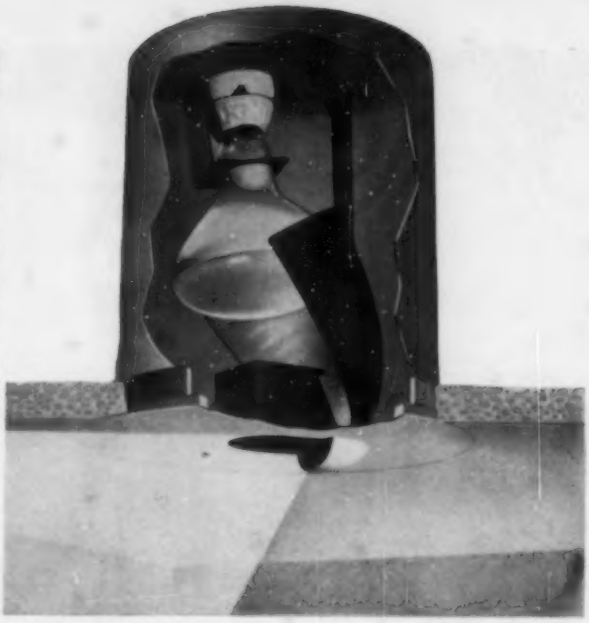

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. . . the Great Name in Lighting!

Designed optics . . . controlled wall lighting from an inconspicuous overhead light source. A specially shaped Alzak finished reflector was created for Kliegl Wall Washer Downlights. This unit, with its uniquely shaped reflector, permits the use of a pinhole aperture and produces a soft overall light pattern without annoying hot spots or scallops.

Kliegl Wall Washers are optically designed to correctly illuminate *any* wall whether it is blank or decorated with pictures, murals or tapestries.

Plan to use Kliegl Wall Washer Downlights in your next project. In the meantime, for complete information, write for our Architectural Lighting Catalog.

lighting

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ORIGINATORS AND MANUFACTURERS OF KLIEGLIGHTS

Sola indoor constant-wattage mercury-lamp transformers install easily, operate lamps down to 20° below zero

Now you can insure that your indoor mercury lighting installation will start and keep going even when temperatures slip far below zero. No longer is it necessary to use special, premium-priced indoor transformers or the still more costly weatherproof outdoor type for low temperature indoor installations. Sola's new standard line of indoor constant-wattage mercury lamp transformers keeps H-1, H-25, and H-33 lamps working down to minus 20°F. Two-lamp and single lamp units are both available for these input voltages: 115, 208, 230, 277, 460, and 575. They are ideal for shed, dock and warehouse installations as well as indoor remote mounting to serve outdoor mercury circuits.

These indoor transformers have new, lighter-weight core and coil construction for easier handling. Long leads and twelve knockouts in the new-designed case permit quick and easy connection. The case is liberally perforated for plenty of air circulation around the core and capacitors to give cool, trouble-free operation.

Listed by Underwriters Laboratories, the new indoor transformers incorporate the well-known Sola constant-wattage circuit which gives you these performance benefits:

Low starting current—limits current during warm-up, eliminates need for heavy wiring and time-delay relays, and permits more lamps to operate on the lighting circuit.

Maintained light output — holds lumen output constant within ±1% for line voltage changes as great as ±13%.

Open and short circuit protection — prevents transformer and wiring from overheating.

Insures rated lamp life — reduces premature lamp failure by providing stable operating conditions.

No dropout when line voltage dips — eliminates lamp dropout even when voltage dips 30% from nominal.

For information, write for Bulletin MVI

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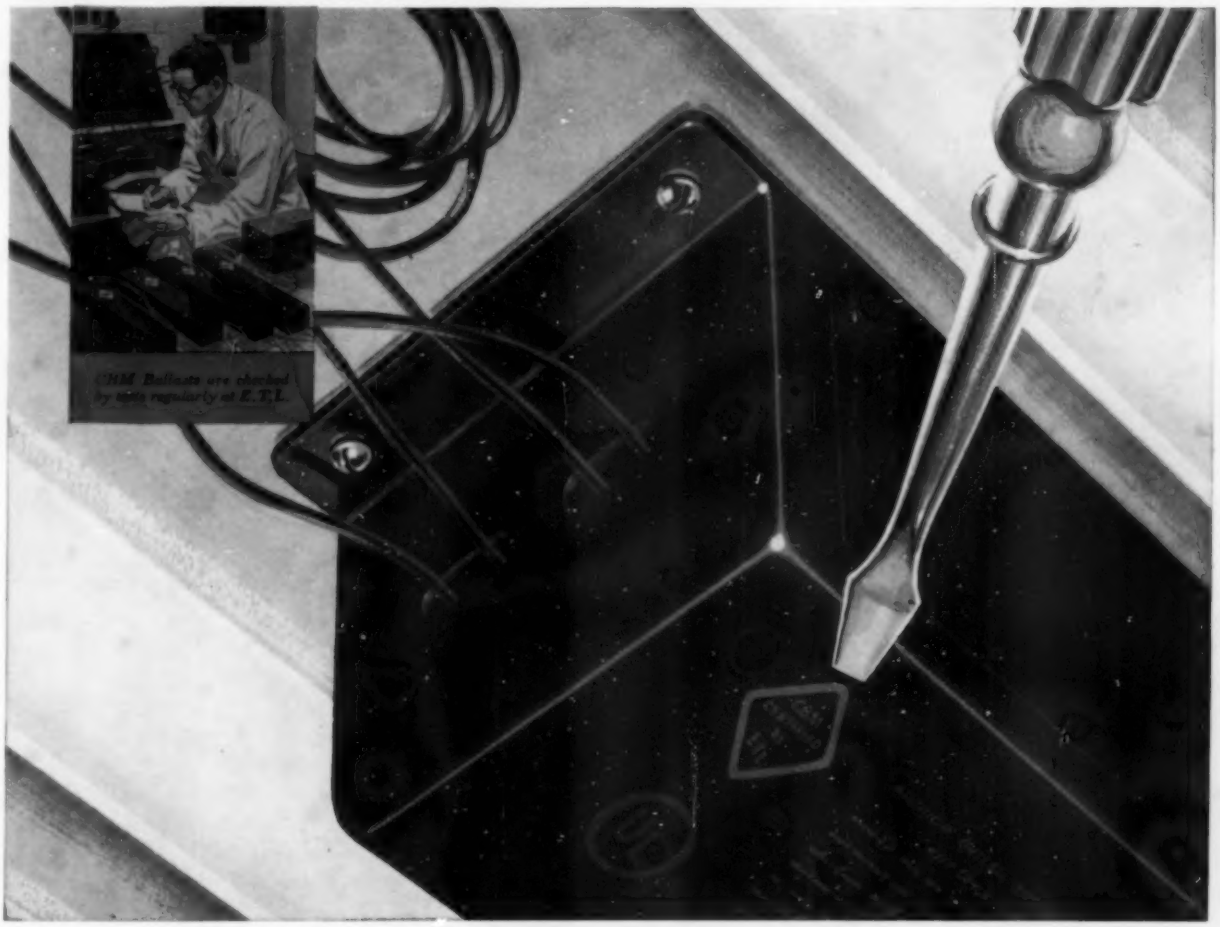

Among them . . . up to 40% more light output and sustained peak light output to give the benefits of today's recommended higher lighting levels. You also get long lamp and ballast life . . . positive starting . . . U. L. listing . . . **in short, performance that meets specified CBM standards** . . . checked and certified by Electrical Testing Laboratories. Enjoy CBM benefits on fixtures that you sell or specify. And to keep pace with CBM progress, ask us to start mailing you "CBM NEWS".

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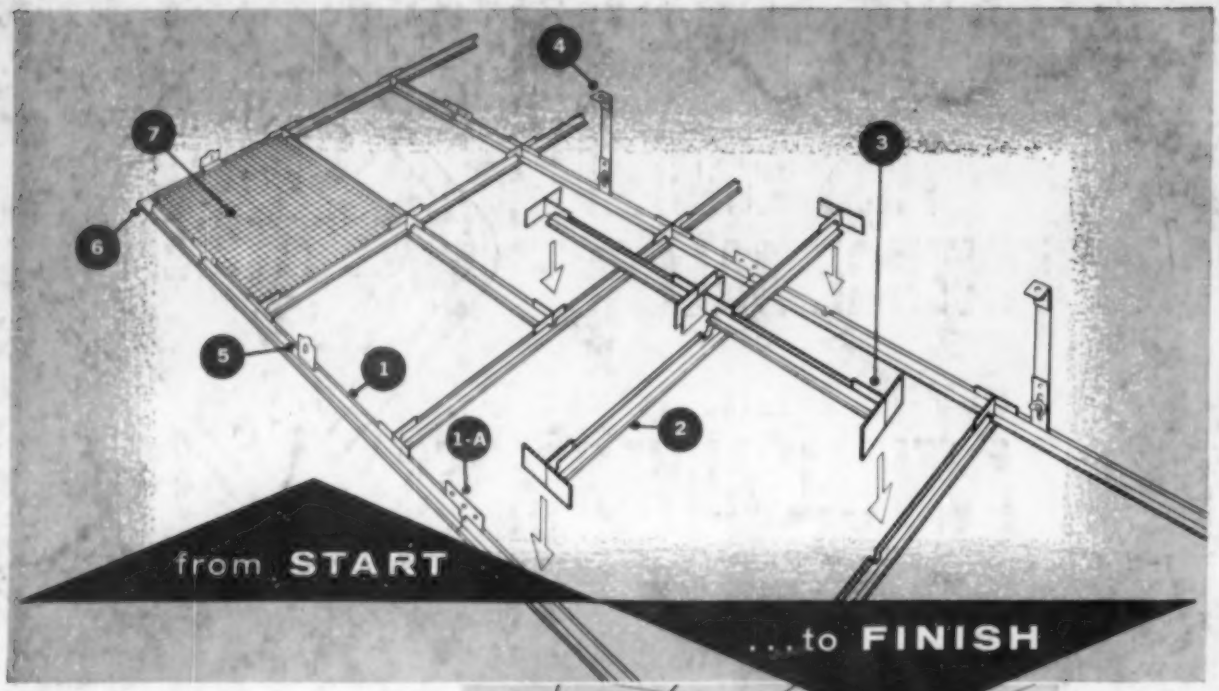

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